Calvert County 2023 Hazard Mitigation Plan

Prepared for:

Calvert County Division of Emergency Management

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Certification of Annual Review Meetings

YEAR	DATE OF MEETING	PUBLIC OUTREACH ADDRESSED? *	SIGNATURE
2023			
2024			
2025			
2026			
2027			

**Confirm yes here annually and describe on record of changes page.*

Record of Changes

DATE	DESCRIPTION OF CHANGE MADE, MITIGATION ACTION COMPLETED, OR PUBLIC OUTREACH PERFORMED	CHANGE MADE BY (PRINT NAME)	CHANGE MADE BY (SIGNATURE)
08/20/2024	Incorporated the 2024 Calvert County Flood Mitigation Plan into the HMP as Appendix K.	Kara R. Buckmaster	Kara R. Buckmaster Digitally signed by Kara R. Buckmaster Date: 2024.09.20 08:52:33 -04'00'

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Acronyms

AACT: American Academy of Clinical Toxicology

ACHA: American College Health Association

ACMT: American College of Medical Toxicology

AHJ: Authority Having Jurisdiction

AMD: Acid Mine Drainage

ANSI: American National Standards Institute

ASAM: American Society of Addiction Medicine

ASHRAE: American Society of Heating, Refrigerating, and Air-Conditioning Engineers

ASIRT: Association for Safe International Road Travel

BFE: Base Flood Elevation

CBRNE: Chemical, Biological, Radiological, Nuclear, or Explosive

CDC: Centers for Disease Control and Prevention

CERT: Community Emergency Response Team

CFR: Code of Federal Regulations

CFS: Commodity Flow Study

CHSN: College Health Surveillance Network

CCIDRAP: Center for Infectious Disease Research and Policy

CRS: Community Rating System

DDAP: Department of Drug and Alcohol Programs

DEA: Drug Enforcement Administration

DFIRM: Digital Flood Insurance Rate Map

DMA: Disaster Mitigation Act

DPS: Department of Public Safety

EF: Enhanced Fujita

EIA: Energy Information Administration

EMA: Emergency Management Agency

EMPG: Emergency Management Performance Grant

EMS: Emergency Medical Services

EOP: Emergency Operations Plan

EPA: Environmental Protection Agency

EPCRA:	Emergency Planning and Community Right-To-Know Act
EPZ:	Emergency Planning Zone
FBI:	Federal Bureau of Investigations
FEMA:	Federal Emergency Management Agency
FMA:	Flood Mitigation Assistance Grant Program
FRA:	Federal Railroad Association
GIS:	Geographic Information Systems/Sciences
HAZUS:	Hazards U.S. Software
HMA:	Hazard Mitigation Assistance
HMEP:	Hazardous Material Emergency Planning Grant
HMGP:	Hazard Mitigation Grant Planning
HMP:	Hazard Mitigation Plan
HMRF:	Hazardous Material Response Fund
HSCA:	Hazardous Sites Cleanup Act
HSGP:	Homeland Security Grant Program
HVE:	Homegrown Violent Extremist
ICC:	International Code Council
IES:	Illuminating Engineering Society
LEPC:	Local Emergency Planning Committee
LGTBQ:	Lesbian, Gay, Bisexual, Trans & Queer
LPT:	Local Planning Team
MAT:	Medication-Assisted Treatment
MDE:	Maryland Department of the Environment
MDOH:	Maryland Department of Health
MD OIT:	Maryland Department of Information Technology
MDOT:	Maryland Department of Transportation
MPC:	Municipalities Planning Code
NARM:	Notification and Resource Manual
NAS:	Neonatal Abstinence Syndrome
NCDC:	National Climatic Data Center
NCEI:	National Centers for Environmental Information
NFIP:	National Flood Insurance Program

NFPA: National Fire Protection Association

NIH: National Institute of Health

NLD: National Levee Database

NOAA: National Oceanic and Atmospheric Administration

NTP: Narcotic Treatment Program

NWS: National Weather Service

OIH: Opioid-Induced Hyperalgesia

OUD: Opioid Use Disorder

PDMP: Prescription Drug Monitoring Program

PDSI: Palmer Drought Severity Index

PHMSA: Pipeline and Hazardous Materials Safety Administration

POD: Points of Dispensing

PWSA: Public Water Service Area

RF: Risk Factor

SARA: Superfund Amendments and Reauthorization Act

SC: Steering Committee

SFHA: Special Flood Hazard Area

TRI: Toxic Release Inventory

UCC: Uniform Construction Code

US HHS: United States Department of Health and Human Services

USACE: Untied States Army Corp of Engineers

USDA: United States Department of Agriculture

USDA FS: United States Department of Agriculture Forest Service

USGS: United States Geological Survey

WL: Working Level

WMD: Weapon of Mass Destruction

WUI: Wildland Urban Interface

Executive Summary

Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. Hazard mitigation focuses attention and resources on county and municipal policies and actions that will produce successive benefits over time. State and local governments engage in hazard mitigation planning to identify risks and vulnerabilities associated with natural as well as human-caused hazards and develop long-term strategies for protecting people and property from future hazard events. Mitigation plans are key to breaking the cycle of disaster damage, reconstruction, and repeated damage. This plan represents the work of citizens, elected and appointed government officials, business leaders, and volunteer and nonprofit groups to protect community assets, preserve the economic viability of the community, and save lives.

In 2023, the Calvert County Division of Emergency Management contracted the services of a consulting agency to revise and update the Calvert County Hazard Mitigation Plan. The plan was successfully updated in accordance with the requirements set forth by MDEM and FEMA. The updated Calvert County Hazard Mitigation Plan was adopted by the Calvert County Commissioners in 2023. All municipalities and communities adopted the 2017 Calvert County Hazard Mitigation Plan as the municipal hazard mitigation plan, and it is anticipated that all participating municipalities and communities will adopt the 2023 Calvert County Hazard Mitigation Plan Update.

The Calvert County Commissioners secured a grant to complete the 2023 update to the Calvert County Hazard Mitigation Plan. MCM Consulting Group, Inc. was hired to assist the county with the update of the plan. The planning kick-off meeting was conducted on March 16th, 2023.

The planning process for the 2023 Calvert County Hazard Mitigation Plan Update consisted of the following:

- Identification and prioritization of the hazards that may affect the county and its municipalities.
- Assessment of the county’s and municipalities’ vulnerability to these hazards.
- Identification of the mitigation actions and projects that can reduce that vulnerability.
- Development of a strategy for implementing the actions and projects, including identifying the agency(ies) responsible for that implementation.

Throughout the planning process, the general public was given the opportunity to comment on the existing HMP and provide suggestions for the updated version. Public meetings were conducted in person and online to address concerns regarding COVID-19. Public meetings were also posted for future viewing by the public. Several meetings were held in person with a virtual option, and participants were invited to submit surveys and other documents via an online survey.

The following hazards are separated into natural and human-caused hazards and listed out alphabetically. All of these hazards were identified by the local planning team as presenting the highest risk to the county and its municipalities:

Natural hazards:

- Coastal Erosion
- Drought
- Earthquake
- Flooding, Flash Flooding, Ice Jam Flooding
- Hail
- Hurricane and Tropical Storm
- Invasive Species
- Landslide
- Pandemic, Epidemic, Endemic, and Infectious Disease
- Radon Exposure
- Subsidence/Sinkhole
- Tornado/Windstorm
- Wildfire
- Winter Storm

Human-caused hazards:

- Civil Disturbance
- Dam Failure
- Emergency Services Shortages
- Environmental Hazards / Hazardous Materials
- Nuclear Incident
- Opioid Epidemic
- Terrorism/Cyberterrorism Incidents
- Transportation Accidents
- Utility Interruption

A total of twenty-three hazards have been identified in the 2023 Calvert County Hazard Mitigation Plan. A total of thirteen identified hazards were listed in the previous 2017 plan update. The new hazards include Coastal Erosion, Flash Flooding, Invasive Species, Landslide, Pandemic, Epidemic, Endemic, and Infectious Disease, Radon Exposure, Wildfire, Civil Disturbance, Dam Failure, Emergency Services, Nuclear Incident, Opioid Epidemic, Transportation Accidents, and Utility Interruptions.

To mitigate against the effects of these hazards, the local planning team identified the following goals for hazard mitigation over the next five years:

- Reduce potential injury/death and damage to existing community assets due to floods, flash floods, and ice jams.
- Reduce potential injury/death and damage to community assets due to all hazards.
- Promote disaster-resistant future development.
- Promote hazard mitigation as a public value in recognition of its importance to the health, safety, and welfare of the population.
- Improve response and recovery capabilities.
- Protect critical infrastructure.

Mitigation actions are specific projects and activities that help achieve goals. A total of sixty-six actions were developed for this plan update as they pertain to hazards identified by the local planning team. Mitigation actions were evaluated by local jurisdictions to address their changes in priorities since the 2017 Calvert County Hazard Mitigation Plan. The 2017 Calvert County Hazard Mitigation Plan consisted of thirty-nine total actions. Of those actions, twenty three actions were identified as being continuous, or still valid, and two were identified as being completed. The individual objectives and actions that will be implemented are shown in Section 6.4. Each municipality was provided the opportunity to submit new project opportunity forms for this update. No records were available for review for project opportunity sheets for the 2017 hazard mitigation plan update. A total of twelve project opportunities were submitted for this plan update.

The 2023 Calvert County Hazard Mitigation Plan is the cornerstone to reducing Calvert County's vulnerability to disasters. It is the commitment to reducing risks from hazards and serves as a guide for decision makers as they commit resources to reducing the effects of hazards. Hazard mitigation is the only phase of emergency management specifically dedicated to breaking the cycle of damage, reconstruction, and repeated damage.

The 2023 Calvert County Hazard Mitigation Plan is a living document that reflects ongoing hazard mitigation activities and requires monitoring, evaluating, and updating to ensure the mitigation actions are implemented. To facilitate the hazard mitigation planning process and adhere to regulatory requirements, the plan will be reviewed annually, and any major revisions will be incorporated into the five-year update.

1. Introduction

1.1. Background

The Calvert County Board of Commissioners, in response to the Disaster Mitigation Act of 2000 (DMA 2000), organized a countywide hazard mitigation planning effort to prepare, adopt, and implement a multi-jurisdictional Hazard Mitigation Plan (HMP) for Calvert County and all of its municipalities and communities. The Calvert County Division of Emergency Management was charged by the Calvert County Board of Commissioners to prepare the 2023 plan. The 2017 HMP has been utilized and maintained during the five-year life cycle.

The Calvert County Board of Commissioners were successful in securing hazard mitigation grant funding to update the county hazard mitigation plan. The pre-disaster mitigation grant funding was administered by the Maryland Department of Emergency Management and provided to Calvert County as a sub-grantee. The Calvert County Board of Commissioners assigned the Calvert County Division of Emergency Management with the primary responsibility to update the hazard mitigation plan. MCM Consulting Group, Inc. was selected to complete the update of the HMP. A local hazard mitigation planning team was developed comprised of government leaders and citizens from Calvert County. This updated HMP will provide another solid foundation for the Calvert County Hazard Mitigation Program.

Hazard mitigation describes sustained actions taken to prevent or minimize long-term risks to life and property from hazards and to create successive benefits over time. Pre-disaster mitigation actions are taken in advance of a hazard event and are essential to breaking the disaster cycles of damage, reconstruction, and repeated damage. With careful selection, successful mitigation actions are cost-effective means of reducing risk of loss over the long term.

Hazard mitigation planning has the potential to produce long-term and recurring benefits. A core assumption of mitigation is that current dollars invested in mitigation practices will significantly reduce the demand for future dollars by lessening the amount needed for recovery, repair, and reconstruction. These mitigation practices will also enable local residents, businesses, and industries to reestablish themselves in the wake of a disaster, getting the economy back on track sooner with less interruption.

1.2. Purpose

The purpose of this all-hazard mitigation plan (HMP) is:

- Protect life, safety, and property by reducing the potential for future damages and economic losses that result from hazards.
- Qualify for additional grant funding, in both the pre-disaster and the post-disaster environment.
- Speed recovery and redevelopment following future disaster events.

- Demonstrate a firm local commitment to hazard mitigation principles.
- Comply with both state and federal legislative requirements for local hazard mitigation plans.

1.3. Scope

This Calvert County Multi-Jurisdictional Hazard Mitigation Plan serves as a framework for saving lives, protecting assets, and preserving the economic viability of the two municipalities in Calvert County. The HMP outlines actions designed to address and reduce the impact of a full range of natural hazards facing Calvert County, including drought, earthquakes, flooding, tornadoes, hurricanes/tropical storms, invasive species, and severe winter weather. Human-caused hazards such as transportation accidents, emergency services shortage, hazardous materials spills, and fires are also addressed.

A multi-jurisdictional planning approach was utilized for the Calvert County HMP update, thereby eliminating the need for each municipality to develop its own approach to hazard mitigation projects, common mitigation goals and objectives, and an evaluation of a broad capabilities assessment examining policies and regulations throughout the county and its municipalities.

1.4. Authority and References

Authority for this plan originates from the following federal sources:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C., Section 322, as amended
- Code of Federal Regulations (CFR), Title 44, Parts 201 and 206
- Disaster Mitigation Act of 2000, Public Law 106-390, as amended.
- National Flood Insurance Act of 1968, as amended, 42 U.S.C. 4001 et seq.

The following Federal Emergency Management Agency (FEMA) guides and reference documents were used to prepare this document:

- FEMA 386-1: Getting Started. September 2002
- FEMA 386-2: Understanding Your Risks: Identifying Hazards and Estimating Losses. August 2001
- FEMA 386-3: Developing the Mitigation Plan. April 2003
- FEMA 386-4: Bringing the Plan to Life. August 2003
- FEMA 386-5: Using Benefit-Cost Review in Mitigation Planning. May 2007
- FEMA 386-6: Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning. May 2005
- FEMA 386-7: Integrating Manmade Hazards into Mitigation Planning. September 2003
- FEMA 386-8: Multijurisdictional Mitigation Planning. August 2006

- FEMA 386-9: Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects. August 2008
- FEMA Local Multi-Hazard Mitigation Planning Guidance. April 19, 2023
- FEMA National Fire Incident Reporting System 5.0: Complete Reference Guide. January 2008
- FEMA Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards. January 2013
- FEMA Rehabilitation of High Hazard Potential Dams: Grant Program Guidance, June 2020

The following Maryland Department of Emergency Management (MDEM) guides and reference documents were used to prepare this document:

- Maryland Department of Emergency Management. Maryland State Hazard Mitigation Plan. 2021.

The following document produced by the National Fire Protection Association (NFPA) provided additional guidance for updating this plan:

- NFPA 1600: Standard on Disaster/Emergency Management and Business Continuity Programs. 2011

2. Community Profile

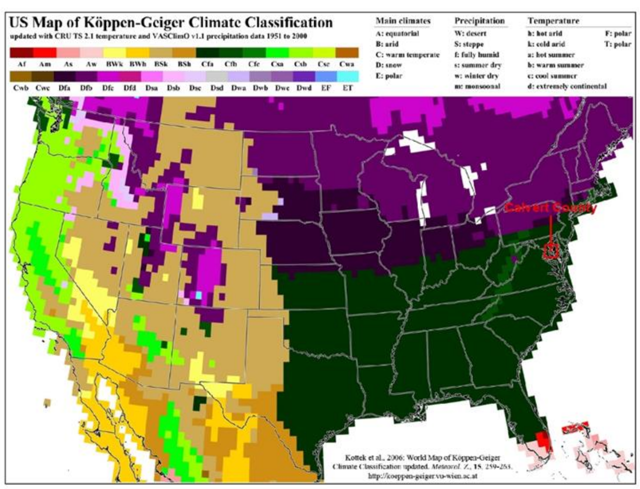
2.1. Geography and the Environment

Calvert County covers approximately 345 square miles and is situated in southcentral Maryland. The county is bordered by Anne Arundel County to the north, Prince George's County to the northwest, Charles County to the west, and St. Mary's County to the south. Calvert County lies within the Atlantic Coastal Plain physiographic province. The county is ranked 14th in terms of population within the State of Maryland. In 2010, Calvert County was also ranked 14th in terms of population and was ranked 15th in Maryland in terms of population in 2000. There is a total of 213 square miles of land and 132 square miles of water in Calvert County, Maryland. Calvert County is the smallest county in the state.

Calvert County presents a typical coastal topographic profile. The surface ranges from coastal cliffs to beaches and has small rolling hills. Elevations in the county range from a high point of 193 feet near north of Sunderland in the north central part of the county and a low of sea level at the Chesapeake Bay along the eastern side of the county.

The Köppen-Geiger Climate Area map classifies Calvert County as humid subtropical or *Cfa* by the designation. This can be seen in *Figure 1 - Köppen-Geiger Climate Map*. Humid subtropical areas are characterized by longer humid and hot summers and mild winter temperatures. Calvert County temperature swings are regulated by the water located on either side of the land in the county in the Chesapeake Bay and the Patuxent River.

Figure 1 - Köppen-Geiger Climate Map



According to current data, the climate in Calvert County is humid, with long humid and hot summers and moderate to mild winters. This can be confirmed with current temperature data for Solomons, located in Calvert County. In the winter, the average temperature is 39.28˚F and the average daily minimum temperature is 20.55˚F. In the summer, the average temperature is

78.72˚F and the average daily maximum temperature is 87.2˚F. The summer temperatures for Calvert County may be slightly milder than expected due to the location of the county near bodies of water, and the wind from the Chesapeake Bay. The average amount of precipitation that occurs in the form of rain for Calvert County is 49.26 inches a year, with most of the rain for the county occurring during the summer months. The wettest months on record from 2001 to 2022 were June, July, and August. Very little precipitation in the form of rain occurs in the winter. The average amount of snowfall each winter for the Solomons monitoring location is approximately 1.67 inches. There are many years in the National Weather Service record that recorded no snow accumulation.

There are numerous streams and creeks in and around Calvert County, but the riverine characteristics are defined by the Patuxent River. The Patuxent River is a primary river that drains into the Chesapeake Bay, and runs along the western side of Calvert County. The following tributaries run through Calvert County:

- Battle Creek
- Back Creek
- Buzzard Island Creek
- Caney Creek
- Chew Creek
- Cocktown Creek
- Fowlers Mill Branch
- Friday Creek
- Graham Creek
- Hall Creek
- Hellen Creek
- Hunting Creek
- Lyons Creek
- Mears Creek
- Reits Creek
- St. John Creek

Calvert County is home to three large watersheds. Those watersheds are listed in the table below, including the Maryland 8-Digit Designation for that watershed. See *Table 1 – Watersheds in Calvert County, MD*.

Table 1 - Watersheds in Calvert County, MD

Watersheds in Calvert County, Maryland	
Name	**Maryland 8-Digit Designation**
Patuxent River – Lower	02131101
Patuxent River – Middle	02131102
West Chesapeake Bay	02131005
Source: Maryland iMap, DNR, 2023	

2.2. Community Facts

Native populations lived in the areas of Calvert County as early as 12,000 years ago and the first indigenous peoples to live in the area of Calvert County were the Piscataway Native Americans. These Native Americans were displaced by colonists in Calvert County due to disease and violence. Calvert County, Maryland was founded in 1654 and was originally named Charles County, after King Charles I of England. Charles County was abolished in 1654 and Calvert

County was established in the same area. The Puritan Assembly changed the name of the county to Patuxent County on October 20, 1654. The Calvert County name, named for the Calvert family, was restored to the county in 1658 and has remained to this day. The Calvert family name is derived from the traditional family name of the Barons of Baltimore and the proprietors of the Colony of Baltimore.

The county seat of Calvert County was previously located in Calvertown, until the county seat was moved in 1722 to the area that would become Prince Frederick. The courthouse for Calvert County in Prince Frederick was completed in 1732.

Calvert County has two incorporated municipalities, and seven Town Centers that have specific boundaries and are used for zoning and development. Town Centers in Calvert County do not have a central, incorporated government, but do allow for the preservation of rural areas and natural areas in the county from development.

The following incorporated municipalities and Town Centers are located in Calvert County, Maryland:

- **Towns (2):** Chesapeake Beach, North Beach
- **Town Centers (7):** Dunkirk, Huntingtown, Lusby, Owings, Prince Frederick (County Seat), St. Leonard, and Solomons

Calvert County has a moderate number of cultural resources including locations that are registered with the National Register of Historic Places (NRHP), as maintained by the United States Department of the Interior (USDI). The Maryland Department of Planning, Maryland Historical Trust lists historic properties by county. Below is a list of the historic places in Calvert County listed in the NRHP:

- All Saints' Church
- Cedar Hill
- Chesapeake Beach Railway Station
- Christ Church
- Cornehill
- Cove Point Lighthouse
- Drum Point Lighthouse
- Grahame House
- J.C. Lore Oyster House
- Joseph Lyons House
- La Veille
- Linden
- Maidstone
- Middleham Chapel
- Morgan Hill Farm
- Patterson Archaeological and Historic District
- Preston-on-the-Patuxent
- Taney Place
- William B. Tennison (Bugeye boat)
- Willow Glenn

Many of these locations listed as cultural resources, buildings, or areas have a long history, and some pre-date the United States. This area of Maryland benefits from older infrastructure being maintained and used over the centuries. The Preston-on-the-Patuxent was constructed in 1725, the Middleham Chapel was constructed in 1748, and Taney Place was constructed in 1750. In total, eleven of the twenty historic properties listed in the National Register of Historic Places were constructed prior to the dawn of the 19th century (1800).

2.3. Population and Demographics

The total population for Calvert County is 92,783 based on the 2020 Decennial United States Census by the United State Census Bureau. The total population change for Calvert County from 2010 to 2020 was an increase of 4,046 or a percent change of 4.56% from 2010. The most populous municipality in the county is the town of Chesapeake Beach, located in the northwest corner of the county. The municipalities in the county had population changes of 10.48% for the town of Chesapeake Beach and 8.49% for the town of North Beach. *Table 2 – Population Change in Calvert County* illustrates the trends and data from the United States Census Bureau from 2010 to 2020.

Table 2 - Population Change in Calvert County

Population Change in Calvert County 2010 - 2020				
Municipality or Town Center	**2010 Census**	**2020 Census**	**Change**	**Percent of Change 2010 - 2020**
Municipality				
Town of Chesapeake Beach	5,753	6,356	603	10.48%
Town of North Beach	1,978	2,146	168	8.49%
Town Centers				
Dunkirk	2,521	2,431	-90	-3.57%
Huntingtown	3,311	3,545	234	7.07%
Lusby	1,835	2,072	237	12.92%
Owings	2,149	2,141	-8	0.37%
Prince Frederick (County Seat)	2,538	3,226	688	27.11
St. Leonard	742	778	36	4.85
Solomons	2,368	2,650	282	11.91
Entire County				
Calvert County	*88,737*	*92,783*	*4,046*	*4.55%*
Source: United States Census Bureau, 2010 and 2020				

Based on information from the American Community Survey (ACS), in 2021, there are approximately 35,501 housing units in Calvert County, Maryland. Of these housing units, there are an estimated 32,751 or 92.3% that are occupied, with an average family size of 2.81 persons. Married couples make up 59.4% of the total number of households in Calvert County. The estimated homeownership rate in Calvert County is 86.7%. Approximately 0.8% of housing in Calvert County is valued between $50,000.00 to $99,999.99. 1.8% of the housing in Calvert County is valued below $50,000.00 while the remaining 97.4% of the housing in Calvert County is valued above $100,000.00. A large portion of the housing in Calvert County (45.3%) is valued between $300,000.00 and $499,999.99.

Based on information provided in the American Community Survey for Calvert County for 2021, the racial composition of the county is 79.3% White, 12.4% Black or African American, 4.3% Hispanic or Latino, 0.1% American Indian and Alaska Native, 2.1% Asian, 0.1% native Hawaiian and other Pacific Islander, and 5.6% two or more races. The median age of Calvert County is 40.5 years of age, which is higher than the Maryland median age of 39.3 years old and the median age of the United States at 38.8 years of age. The percentage of Calvert County under the age of 5 years old is 5.2%, under the age of 18 is 23.4%, between the ages of 18 and 64 years of age is 56.4%, and aged 65 years and older is 15%.

The median household income for households in Calvert County is $120,295.00 and the poverty rate of Calvert County is 4.9% of the total population. The poverty rate for the State of Maryland as a whole is 10.3%. There are approximately 7,750 veterans in Calvert County. Minimal information was available at the time of this writing for Calvert County veteran statistic information, but the ACS estimates that 2.1% of veterans in the county are unemployed. This equates to approximately 163 veterans.

The COVID-19 pandemic created an increase in unemployment and interruptions in employment throughout the United States, to include Maryland and Calvert County. According to the Maryland State Archives, there was a large spike in unemployment in Calvert County. At the height of the COVID-19 pandemic in 2020, unemployment for Calvert County was up to 5% of the total workforce for the county. That is significantly higher than the unemployment rates for the calendar years 2018 and 2019, at 3.4% and 3.0% respectively. *Table 3 – Calvert County Unemployment Rate 2018 – 2022* illustrates this information from the Maryland State Archives. The total civilian workforce in Calvert County from the ACS for 2021 was 49,315 people and the number of people working in the Armed Forces is 1,032 service members.

Table 3 - Calvert County Unemployment Rate 2018-2022

Calvert County, Maryland Unemployment Rate 2018 - 2022	
Year	**Unemployment Percentage**
2018	3.4%
2019	3.0%
2020	5.0%
2021	4.2%
2022	2.9%
Source: Maryland State Archives. Maryland at a Glance. "Unemployment Rates," May 3, 2023. https://msa.maryland.gov/msa/mdmanual/01glance/economy/html/unemployrates.html	

Calvert County's leading industries, by number of employees, are education, health care, social assistance, and public administration. The primary employment industries within Calvert County are displayed below in *Table 4 – Calvert County's Top Industries by Employees*.

Table 4 - Calvert County's Top Industries by Employees

Calvert County Top Industries by Employees		
Rank	**Industry**	**Number of Employees**
1	Educational Services, Health Care, and Social Assistance	10,113
2	Public Administration	7,902
3	Professional, scientific, and management	6,233
4	Construction	5,620
5	Arts, entertainment, recreation, and accommodation	3,503
6	Retail Trade	3,455
7	Transporting and warehousing, and utilities	2,808
8	Other services, excluding public administration	2,443
9	Manufacturing	2,040
10	Wholesale trade	972
Total of Top Ten Industries:		**45,089**
Source: ACS, Economic Characteristics, 2021		

2.4. Land Use and Development

Calvert County is composed of two incorporated municipalities and seven Town Centers. These locations are the more developed portions of Calvert County and new development occurs in these locations.

Calvert County has a wide range of land cover and land use. The county is broken down into different land cover types. The county has a large amount of forested land. This land is located primarily in the central and southern areas of the county. This forested land also includes state parks and natural areas. The most prominent state park in Calvert County is the Calvert Cliffs State Park, located near Lusby. Other, smaller parks in Calvert County that are forested include the Dunkirk District Park, Flag Ponds Nature Park, Hallowing Point Park, Jefferson Patterson Park, and Kings Landing Park. Forested areas make up approximately 45.6% of the county's land area.

Wetlands are also a prominent land cover in Calvert County, Maryland. Wetlands make up approximately 2% of the land area in Calvert County, but do provide a large amount of environmental benefits and natural resource protection. A prominent example of a wetland in Calvert County is the Battle Creek Cypress Swamp Sanctuary. The sanctuary is a large area of cypress swamp and was designated a national natural landmark in 1965.

Development in Calvert County is heaviest in the northeastern and southern portions of the county. Residential areas, including the incorporated municipalities and the Town Centers, make up 33.6% of the total land area in Calvert County. Low density residential land has the largest percentage, based on information provided. Industrial land makes up less than 1% of the total land area and institutional land accounts for 1.2% of the land area. Development from 2018 to 2023 has occurred around the Town Centers and communities in Calvert County. The Calvert County comprehensive plan outlines that development in Calvert County is "concentrated in existing population and business centers, growth areas adjacent to these centers, or strategically selected new centers". (Calvert County Comprehensive Plan, 2022) This focuses on growth in the two incorporated municipalities and the seven Town Centers. Future development will continue to be focused in these areas of Calvert County, but development could occur in more areas.

The Calvert County Comprehensive Plan redirects the majority of development in the county towards creating mixed-use Town Centers that are desirable places to live, work, and shop. This Town Center development is coupled with increased preservation of agricultural and forested areas to preserve cultural and natural resources throughout the county. These are also currently several proposed changes to the county code to reduce vulnerability in hazard-prone areas. One such proposed change would increase the freeboard requirement for new structures in the floodplain from 2 feet to 3 feet. Lastly, development planning in Calvert County maintains an approach focused on the sustainability and uses Adequate Public Facility Regulations to support policies that link the amount, locations, and rate of residential growth in the county to land use objectives including highway, school, water quality, and aquifer capacities.

Development being directed to these areas decreases the amount of land being developed, and reduces the risk of developed areas to natural hazards. The Town Centers are located in areas of minimal risk to most natural hazards, except for natural hazards that have the ability to impact all of the county similarly. Both of the Towns, Chesapeake Beach and North Beach, are moderately vulnerable to all natural hazards, including the hazards that have the ability to impact all of the county in similar ways. No major developments to date have increased or decreased the vulnerability to the Town of Chesapeake Beach or the Town of North Beach.

Development in Calvert County will also take into account unserved, underserved, and socially vulnerable populations. These populations will be taken into consideration when developing specific community lifelines, including areas of assistance for homeless and unsheltered populations, in Calvert County.

Specific land cover and development areas can be seen in *Figure 4 – Calvert County Land Cover*. Also, the percentage of each land cover type in Calvert County can be seen in *Table 5 – Calvert County Land Cover and Percentages*.

Table 5 - Calvert County Land Cover and Percentages

Calvert County Land Cover and Percentages	
Land Cover Type	**Percentage of Land Cover**
Agriculture	14.2%

Calvert County Land Cover and Percentages	
Land Cover Type	**Percentage of Land Cover**
Barren Land	0.2%
Commercial	0.9%
Forest	45.6%
High Density Residential	0.4%
Industrial	0.6%
Institutional	1.2%
Low Density Residential	21.2%
Medium Density Residential	4.3%
Other Developed Land	0.7%
Transportation	0.4%
Very Low Density Residential	7.7%
Water	0.8%
Wetlands	2.0%
Source: MD OIT, Land Use/Cover Data, 2023	

2.5. Data Limitations

The following data sources were used during the update process:

- United States Census Bureau (USCB)
- National Climatic Data Center (NCDC)
- National Oceanic and Atmospheric Administration (NOAA)
- National Weather Service (NWS)
- Calvert County Comprehensive Plan 2022

The countywide Digital Flood Insurance Rate Maps (DFIRM) were used for all flood risk analysis and estimation of loss in conjunction with FEMA’s HAZUS-MH software. The Calvert County DFIRMs were approved and effective in 2011 and 2014. The DFIRM database provides flood frequency and elevation information used in the flood hazard risk assessment. Other Calvert County GIS datasets including road centerlines, structures, and municipalities were utilized in conjunction with the DFIRM data.

In order to assess the vulnerability of different jurisdictions to the hazards, data on past occurrences of storms and damaging weather events was compiled. A large number of natural-hazard events were gathered from the National Climatic Data Center (NCDC) database for past storm events. The NCDC is a division of the United States Department of Commerce’s National Oceanic and Atmospheric Administration (NOAA). Information on hazard events such as flooding, flash flooding, winter weather, winter storms, and windstorms is compiled by the NCDC from data gathered by the National Weather Service (NWS), another division of NOAA. The data is then presented by the NCDC as tabular data that can be queried in the United States Storm Events Database, which “documents the occurrences of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce" (NOAA, 2006). The classification of storm events in the database is based off of collected data from around the United States and the State of Maryland. This means that the data may not be filed under the correct storm or event category due to use input error. The reason for this data issue results from some storms falling under multiple categories, including but not limited to winter storm, ice storm, tornado, hurricane/tropical storm, flooding, and flash flooding. Many of the events listed in the United States Storm Events Database can fall under more than one of these categories. In an effort to include a comprehensive list of prior storm events for Calvert County, search queries with multiple storm classifications were conducted for each hazard.

Throughout the risk assessment and vulnerability assessment included in section 4 of this hazard mitigation plan, descriptions of limited data indicate some areas in which the Town Centers, the incorporated municipalities, and the county can improve their ability to identify vulnerable structures and improve loss estimates. As the municipal and county governments work to increase their overall technical capability and implement comprehensive planning goals, they will also attempt to improve the ability to identify areas of increased vulnerability.

This hazard mitigation plan evaluates the vulnerability of the county's community lifelines. For the purposes of this plan, community lifeline facilities are those entities that are essential to the health, welfare, and safety of the community. This includes but it not limited to airports, emergency medical service (EMS) stations, communication facilities including towers, day care centers and preschools, fire departments, hospitals and medical facilities, police departments, schools, and senior living facilities. The locations of these facilities were provided by the Calvert County GIS Department, and additional research was completed to identify further community lifelines.

Community lifelines are broken down into seven categories based on FEMA descriptions:

- **Safety and Security:** Law Enforcement/Security, Fire Service, Search and Rescue, Government Service, Community Safety
- **Food, Water, Shelter:** Agriculture, Shelters for homeless, displaced, and unsheltered persons, Food Banks
- **Health and Medical:** Medical Care, Public Health, Patient Movement, Medical Supply Chain, Facility Management
- **Energy:** Power Grid, Fuel
- **Communications:** Infrastructure, Responder Communications, Alerts, Warnings, and Messages, Finance, 911 and Dispatch
- **Transportation:** Highway/Roadway/Motor Vehicle, Mass Transit, Railway, Aviation, Marine
- **Hazardous Materials:** Facilities, HazMat, Pollutants, Contaminants

Geographic Information Systems (GIS) Data

GIS data was utilized in risk assessment, estimation of loss and the development of map products for the hazard mitigation plan update. A foundation of data was available from the Calvert County GIS Department. Some of the utilized data was downloaded from the Maryland Department of Information Technology's (MDIT) GIS Data Catalog. A large portion of the plan utilizes census data from the United States Census Bureau, including the 2020 decennial census.

The Calvert County GIS Department provided the following layers for use in the development of hazard profiles and hazard profile mapping for the Calvert County 2023 Hazard Mitigation Plan Update:

- Calvert County address points
- Calvert County EMS stations
- Calvert County fire stations
- Calvert County municipal boundaries
- Calvert County police stations
- Calvert County road centerlines

The following GIS data layers were developed for use in the Calvert County 2023 Hazard Mitigation Plan Update or compiled for use in the document:

- Calvert County boundary
- Calvert County drought data (for Maryland)
- Calvert County elevation data
- Calvert County historic tornado tracks
- Calvert County lakes and small waterbodies
- Calvert County National Risk Index (NRI) data
- Calvert County slope data
- Calvert County streams and creeks

Figure 2 - Calvert County Basemap

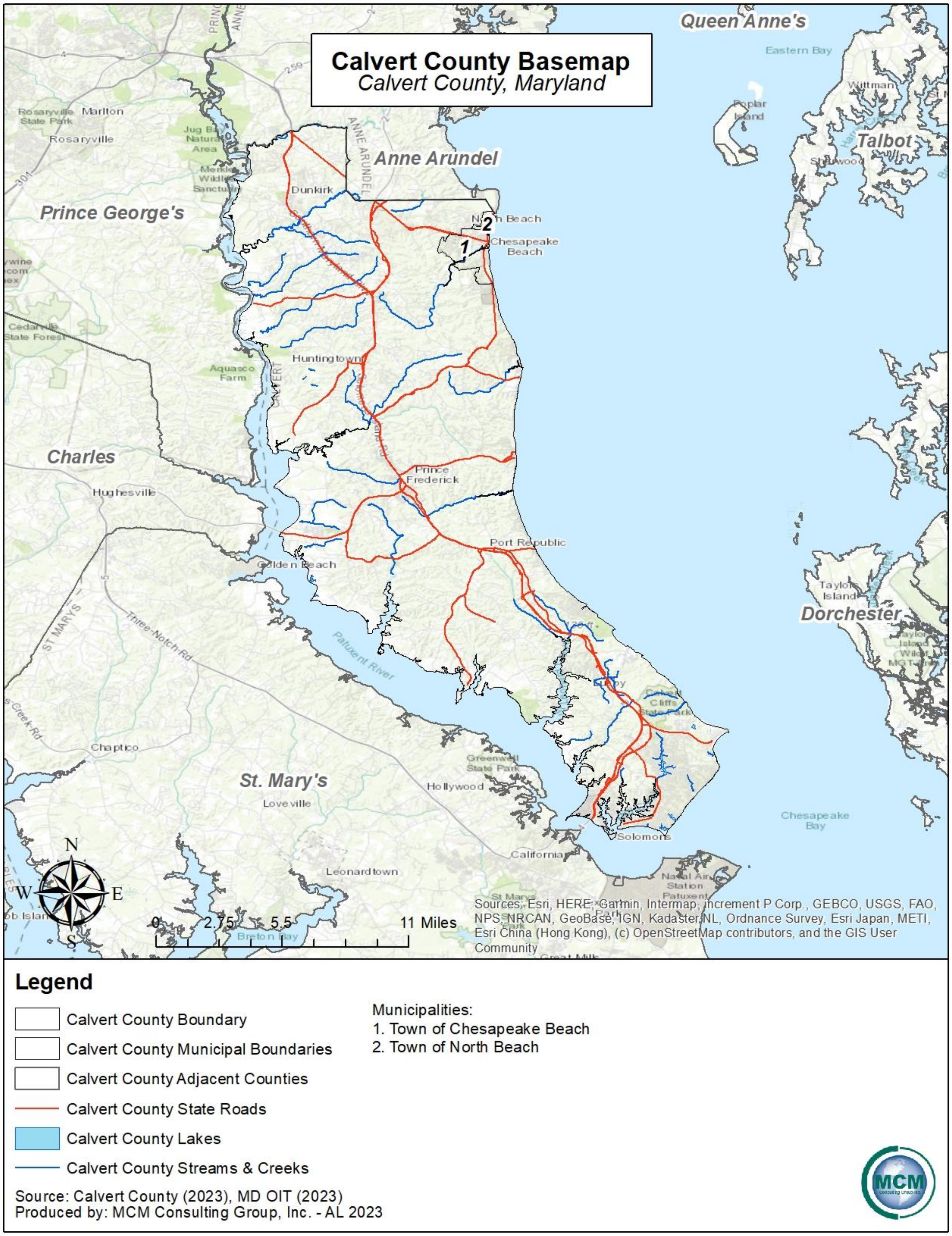


Figure 3 - Calvert County Population Density

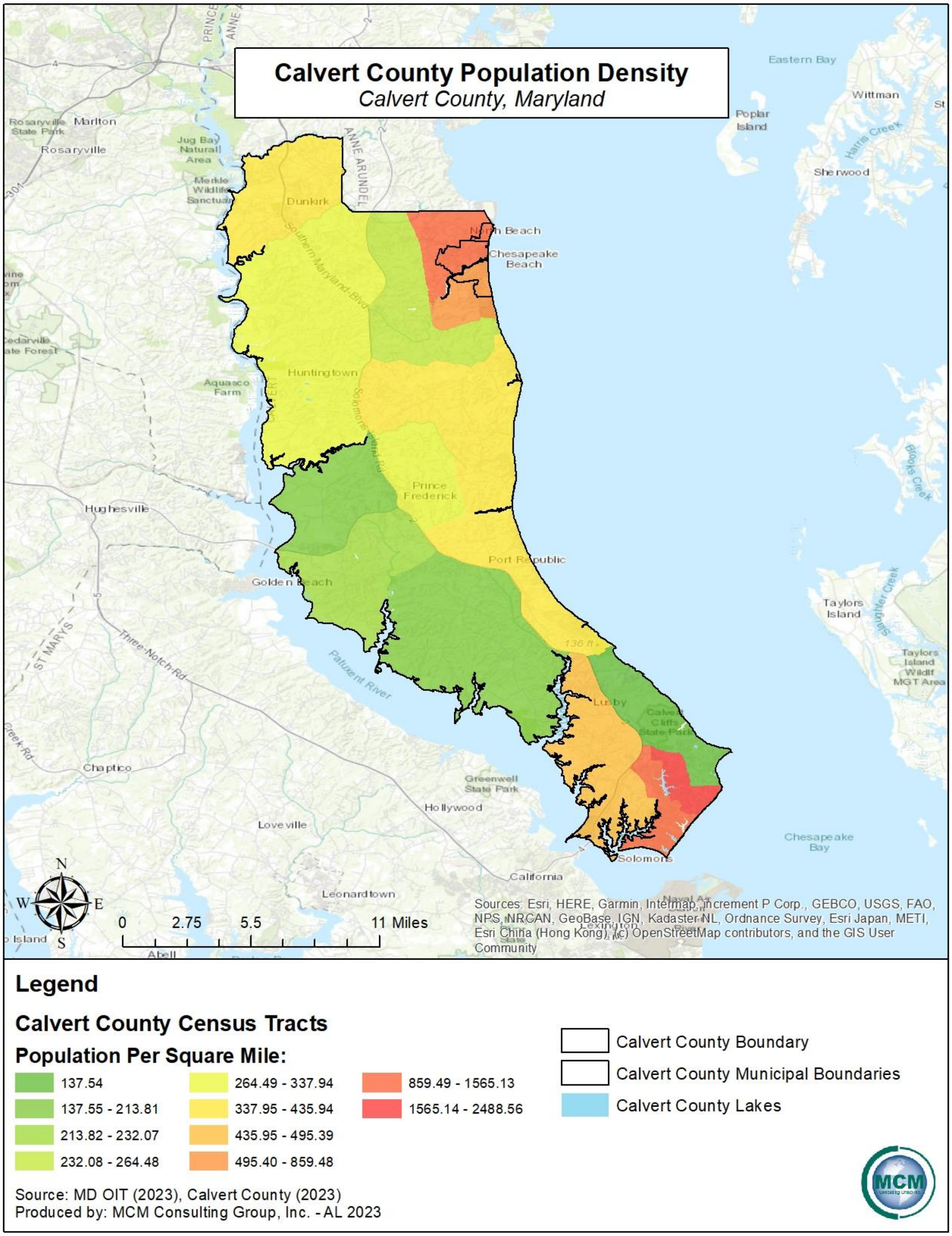
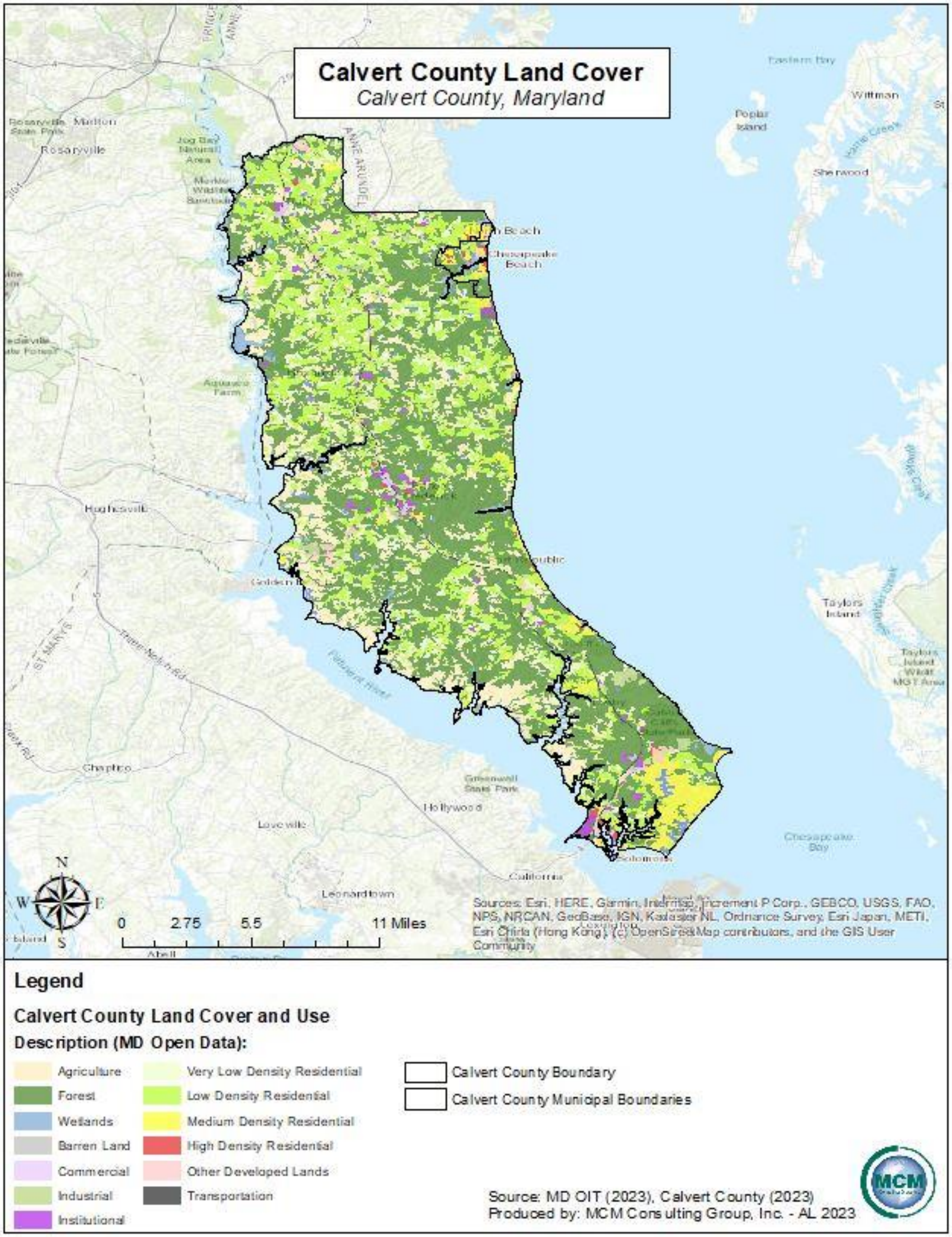


Figure 4 - Calvert County Land Cover



3. Planning Process

3.1. Update Process and Participation Summary

The Calvert County Hazard Mitigation Plan update began February 16th, 2023. The Calvert County Commissioners were able to secure a hazard mitigation grant to start the process. The Calvert County Division of Emergency Management was identified as the lead agency for the Calvert County Hazard Mitigation Plan update. The planning process involved a variety of key decision makers and stakeholders within Calvert County. Calvert County immediately determined that the utilization of a contracted consulting agency would be necessary to assist with the plan update process. MCM Consulting Group, Inc. was selected as the contracted consulting agency to complete the update of the hazard mitigation plan. The core hazard mitigation team, which was referred to as the steering committee, included officials from the Calvert County Division of Emergency Management and MCM Consulting Group, Inc. (MCM).

The process was developed around the requirements laid out in the Federal Emergency Management Agency (FEMA) Local Hazard Mitigation Crosswalk, referenced throughout this plan, as well as numerous other guidance documents including, but not limited to, FEMA's State and Local Mitigation Planning How-to Guide series of documents (FEMA 386-series), and the National Fire Protection Association (NFPA) 1600 Standard on Disaster/Emergency Management and Business Continuity Programs.

MCM Consulting Group, Inc. assisted Calvert County Division of Emergency Management in coordinating and leading public involvement meetings, local planning team meetings, analysis, and the writing of the updated HMP. The Calvert County Local Planning Team (LPT) worked closely with MCM in the writing and review of the HMP. MCM conducted project meetings and local planning team meetings throughout the update process. Due to COVID-19, meetings were held with the option to attend virtually. Meeting agendas, meeting minutes and sign-in sheets were developed and maintained for each meeting conducted by MCM. These documents are detailed in Appendix C of this plan.

Public meetings with local elected officials were held, as well as work sessions and in-progress review meetings with the Calvert County Local Planning Team and staff. At each of the public meetings, respecting the importance of local knowledge, municipal officials were strongly encouraged to submit hazard mitigation project opportunity forms, complete their respective portions of the capability's assessment and review, and eventually adopt the county hazard mitigation plan. Calvert County will continue to work with all local municipalities to collect local hazard mitigation project opportunities.

The HMP planning process consisted of:

- Applying for and receiving a hazard mitigation planning grant (HMPG) to fund the planning project.
- Announcing the initiative via press releases and postings on the county website.
- Involving elected and appointed county and municipal officials in a series of meetings, training sessions, and workshops.
- Identifying capabilities and reviewing the information with the municipalities.
- Identifying hazards.
- Assessment of risk and analyzing vulnerabilities.
- Identifying mitigation strategies, goals, and objectives.
- Developing an implementation plan.
- Announcing completion via press releases and postings on the county website.
- Plan adoption at a public meeting of the Calvert County Board of Commissioners.
- Plan submission to MDEM and FEMA.

The 2023 Calvert County HMP was completed August 21st, 2023. The 2023 Calvert County HMP has added additional hazard profiles to the HMP, and these additional profiles increased the subsections in section 4.3 of the HMP.

3.2. The Planning Team

The 2023 Calvert County Hazard Mitigation Plan update was led by the Calvert County Steering Committee. The Calvert County Steering Committee provided guidance and leadership for the overall project. The steering committee assisted MCM Consulting Group, Inc. with dissemination of information and administrative tasks. *Table 6 – Steering Committee* outlines the individuals that comprised this team.

Table 6 - Steering Committee

Calvert County Hazard Mitigation Plan Update Steering Committee		
Name	**Organization**	**Position**
Kara Buckmaster	Division of Emergency Management	Acting Division Chief
Michael Grierson	Division of Emergency Management	Division Chief
Stacy O’Donnell	Division of Emergency Management	Mitigation Specialist
Michael Rearick	MCM Consulting Group, Inc.	Director of Operations
Adam Leister	MCM Consulting Group, Inc.	Senior GIS Consultant
Daniel Becker	MCM Consulting Group, Inc.	Consultant

In order to represent the county, the Calvert County Steering Committee developed a diversified list of potential local planning team (LPT) members. Members that participated in the 2017 hazard mitigation plan were highly encouraged to join the 2023 team. The steering committee then provided invitations to the prospective members and provided a description of duties to serve on the LPT. The invitations for members of the LPT were disseminated by the Calvert

County Division of Emergency Management utilizing letters, email, and telephone calls. These invitations included local and regional agencies involved in HMP activities, agencies with the authority to regulate development, neighboring communities, businesses and academia, and representatives for county offices and agencies involved in reaching out to socially vulnerable populations.

All neighboring counties were provided an opportunity to participate in the planning and review process of the Calvert County 2023 Hazard Mitigation Plan. The opportunity to review the plan was presented in an email on July 28th, 2023, to the following adjacent counties: Anne Arundel County (Director, Office of Emergency Management), Charles County (Director, Department of Emergency Services), Prince George's County (Director, Office of Homeland Security), and St. Mary's County (Emergency Manager, Office of Emergency Services). Of these, members from Anne Arundel County Office of Emergency Management (Project Development Administrator) and Prince George's County Office of Emergency Management (Emergency Management Specialist) provided thoughtful and relevant comments on the plan to the Calvert County local planning team. Their requested comments were reviewed and integrated into the plan to ensure continued collaboration and engagement between neighboring communities and counties.

The Town of Chesapeake Beach and the Town of North Beach, being municipalities in Calvert County, were also engaged and participated throughout the planning and review process of the Calvert County 2023 Hazard Mitigation Plan. Additionally, utility representatives were invited to participate in the hazard mitigation planning process including a representative from BHE GT&S (Safety Officer) and a representative from the Calvert Cliffs Nuclear Power Plant (Senior Emergency Management Specialist). Lastly, the Calvert County Department of Public Works was also invited to participate throughout the planning and review process to provide information on utilities and critical infrastructure in Calvert County. Participation and feedback from these stakeholder groups informed both the risk assessment and capability assessment processes as well as the mitigation strategy development. More direct outreach to other agency partners for local planning team coordination will continue to increase and will result in a more comprehensive team for future hazard mitigation updates.

Although local dam owners were not directly invited to participate during this update process, outreach was achieved to those individuals, and the public, via news articles, the updates to the county website, and the updates to the county social media pages during the hazard mitigation update process. In the future, those dam owners and state representatives for dam safety will be invited to the local planning team for the Calvert County Hazard Mitigation Planning Program to foster greater collaboration and community involvement regarding dam safety.

Specifically, the Calvert County Office of Community Resources was involved in the local planning team and presented information relevant to LPT on socially vulnerable populations. Multiple members of the LPT were representatives from the Calvert County Department of

Planning & Zoning to ensure that the Department of Planning & Zoning had an active voice in the plan development and allowed them to increase their awareness of threats and hazards that have the ability to impact Calvert County. These individuals on the LPT are directly involved in the plan integrations at the local jurisdictional level, including with the Town Centers in Calvert County. Calvert County also invited local dam owners and stakeholders to the planning process and for them to participate in the local planning team. The LPT worked throughout the process to plan and hold meetings, collect information, and conduct public outreach.

The stakeholders listed in *Table 7 – Local Planning Team* served on the 2023 Calvert County Hazard Mitigation Local Planning Team, actively participated in the planning process by attending meetings, completing assessments, surveys, and worksheets and/or submitting comments.

Table 7 - Local Planning Team

Calvert County Hazard Mitigation Plan Local Planning Team		
Name	**Organization**	**Position**
Mike Grierson	Calvert County Division of Emergency Management	Deputy Director of Public Safety
Colton Pounsberry	Calvert County Division of Emergency Management	Emergency Management Analyst
Stacy O'Donnell	Calvert County Division of Emergency Management	Emergency Management Mitigation Specialist
Kara Buckmaster	Calvert County Division of Emergency Management	Acting Division Chief
Tom Lithe	Town of North Beach	Director of Development
Holly Wahl	Town of Chesapeake Beach	Town Administrator
Amalia Pleake-Tamm	Calvert County Office of Planning & Zoning	Env. Planner
Geoffrey Westbrook	Calvert Soil Conservation District	CSCD District Manager
Ron Marney	Calvert County Office of Planning & Zoning	Env. Planning Regulator
Bob Branham	Calvert County Department of Parks and Recreation	Deputy Director of Parks and Recreation
Kat Poff	Calvert County Technology Services	Deputy Director
Chris Sperling	Calvert County Office of Planning & Zoning	Planner III
Calvin Strozier	Calvert County Technology Services	GIS Analyst
Matt Cumers	Calvert County Health Department	Environmental Health Director
Julianne Oberg	Calvert County Economic Development	Director
Jacquelyn Culver	Calvert County Office of Community Resources	Sp. Project Manager

Calvert County Hazard Mitigation Plan Local Planning Team		
Name	**Organization**	**Position**
Brian Ficke	Calvert Cliffs	Senior Emergency Preparedness Specialist
Jennifer Moreland	Calvert County Office of Community Resources	Director

3.3. Meetings and Documentation

Meetings with local elected officials and the local planning team were held as needed. At each of the meetings, municipal officials were strongly encouraged to submit hazard mitigation project opportunity forms, complete their respective portions of the capability assessment, review and eventually adopt the multi-jurisdictional HMP. *Table 8 – HMP Process Timeline* lists the meetings held during the HMP planning process, which organizations and municipalities attended and the topic that was discussed at each meeting. All meeting agendas, sign-in sheets, presentation slides, and other documentation is in Appendix C.

The draft plan was made available for public review on July 26th, 2023. The draft was advertised on Calvert County's social media page and was made available digitally on the Calvert County website at:

https://www.calvertcountymd.gov/3053/Hazard-Mitigation

The public comment period remained open until August 24th, 2023. All public comments were submitted via an online survey or in writing to Kara Buckmaster at the Calvert County Division of Emergency Management. Public commenting was available during the public comment period via a Survey Monkey link that was advertised on the county website and social media pages. All of the public comments that were received during this planning process can be found in Appendix C – Support Documentation.

Table 8 - HMP Process Timeline

Calvert County HMP Process Timeline		
Date	**Meeting**	**Description**
02/16/2023	Calvert County Hazard Mitigation Plan Steering Committee kickoff meeting	Meeting was used to determine people to invite to the local planning team and to review the project schedule.
03/15/2023	Calvert County HMP Local Planning Team kickoff meeting	Meeting was used to review the project schedule and discuss roles and responsibilities for the hazard mitigation plan. The initial worksheets were introduced and reviewed (Hazard ID, Capability Assessment, and NFIP Survey).

Calvert County HMP Process Timeline		
Date	**Meeting**	**Description**
04/05/2023	Local Planning Team risk assessment meeting	Meeting was used to review risk factor assessment items. Selection of hazards for the 2023 hazard mitigation plan was conducted and the risk factor assessment tool was reviewed. Established that risk factor assessment will be completed at the next meeting.
04/19/2023	Local Planning Team continued risk factor assessment and introduction to mitigation strategy meeting	Meeting was used to review the current schedule, risk factor assessment, and mitigation strategy. The risk factor assessments that were completed were discussed. Mitigation strategy items were reviewed and discussed initial goals, objectives, and actions from the previous plan. Current project opportunities were also reviewed.
05/03/2023	Local Planning Team mitigation strategy meeting	Meeting was used to discuss the list of 2017 hazards and the newly identified hazards. A completed risk factor assessment was conducted for each hazard, and hazard profile development was reviewed. 2017 mitigation actions and project opportunities were also reviewed. The community preparedness survey results were reviewed and discussed.
05/04/2023	Municipal meeting for project opportunities	Meeting was used to go over the current schedule and mitigation project opportunity forms. Mitigation project opportunities were discussed and as well as mitigation project opportunities vs. actions.
05/17/2023	Local Planning Team meeting	Meeting was used to review mitigation goals and objectives, actions, and project opportunities. The goals and objectives for the 2023 plan were drafted and revised. Mitigation action review completion was started by the Division of Emergency Management. The status of project opportunities were discussed and due on May 31, 2023.

Calvert County HMP Process Timeline		
Date	**Meeting**	**Description**
06/14/2023	Local Planning Team mitigation strategy meeting	Meeting was used to go over mitigation actions, project opportunities, and the upcoming public meeting. 2023 mitigation actions were developed, and the 2017 mitigation action documents were reviewed. Submitted project opportunity forms were reviewed.
06/14/2023	Public risk assessment section meeting	Meeting was used to offer the public an opportunity to review the risk assessment section of the 2023 hazard mitigation plan.
06/21/2023	Local Planning Team meeting	Meeting was used to finalize the 2023 Mitigation Action Plan and to establish evaluation and prioritization of the 2023 mitigation action plan.
07/19/2023	Local Planning Team and Public meeting	This meeting was used to finalize sections of the mitigation strategy section including the mitigation action evaluation and prioritization.
07/26/2023 – 08/25/2023	Public comment period	This time was used as the public comment period for the Calvert County HMP.
07/26/2023 – 08/25/2023	MDEM courtesy review	This time was used by MDEM to review the Calvert County HMP prior to FEMA submission.

3.4. Public and Stakeholder Participation

Calvert County engaged numerous stakeholders and encouraged public participation during the HMP update process. Advertisements for public meetings were completed utilizing the Calvert County website. Copies of those advertisements are in Appendix C. Municipalities and other county entities were invited to participate in various meetings and encouraged to review and update various worksheets and surveys. Copies of all meeting agendas, meeting minutes and sign-in sheets are located in Appendix C. Worksheets and surveys completed by the municipalities and other stakeholders are located in appendices of this plan update as well. Municipalities were also encouraged to review hazard mitigation related items with other constituents located in the municipality like businesses, academia, private and nonprofit interests.

The tools listed below were distributed with meeting invitations, provided directly to municipalities for completion and return to the Calvert County Division of Emergency Management or at meetings to solicit information, data, and comments from both local municipalities and other key stakeholders. Responses to these worksheets and surveys are available for review at the Calvert County Division of Emergency Management.

1. **Risk Assessment Hazard Identification and Risk Evaluation Worksheet**: Capitalizes on local knowledge to evaluate the change in the frequency of occurrence, magnitude, or impact and/or geographic extent of existing hazards and allows communities to evaluate hazards not previously profiled in the hazard mitigation process.
2. **Capability Assessment Survey**: Collects information on local planning, regulatory, administrative, technical, fiscal, and political capabilities that can be included in the countywide mitigation strategy.
3. **Municipal Project Opportunity Forms and Mitigation Actions**: Copies of the 2018 mitigation opportunity forms that were included in the current HMP were provided to the municipalities for review and amendment. These opportunities are located in Appendix G. The previous mitigation actions were provided and reviewed at update meetings. New 2023 municipal project opportunity forms are included as well, located in Appendix G.

In an effort to capture public input, the Calvert County LPT held in person meetings and offered on-line surveys. Members of the public were also encouraged to contact Calvert County Division of Emergency Management or MCM Consulting Group, Inc. with any comments or questions regarding this update. Any public comment that was received during public meetings or during the draft review of the plan were documented and included in the plan. Copies of newspaper public meeting notices, website posted public notices, and other correspondence are included in Appendix C of this plan.

Information on the planning process was also posted on the county website, social media pages, and YouTube for ease of access to all residents of the county, including the socially vulnerable.

Calvert County and MCM Consulting Group, Inc. held two public meetings and both of those meeting were recorded and posted to the Calvert County government YouTube page for future viewing. The links for the public meetings are listed below:

- Risk assessment section public meeting (06/14/2023): https://www.youtube.com/watch?v=yx1DqQWOn-g
- Draft plan public meeting (07/19/2023): https://www.youtube.com/watch?v=OVgxhg6BFWA

Calvert County invited all contiguous counties to review the 2023 draft hazard mitigation plan. A letter was sent to the emergency management coordinator in Anne Arundel, Charles, Prince George's, and St. Mary's counties in Maryland, on July 26th, 2023. Copies of these letters are included in Appendix C – Support Documentation.

3.5. Multi-Jurisdictional Planning

Calvert County used an open, public process to prepare this HMP. Meetings and letters to municipal officials were conducted to inform and educate them about hazard mitigation planning and its local requirements. Municipal officials provided information related to existing codes and ordinances, the risk and impacts of known hazards on local infrastructure and critical facilities and recommendations for related mitigation opportunities. The pinnacle to the municipal involvement process was the adoption of the final plan. *Table 9 – Municipality Worksheets, Surveys, and Forms Participation* reflects the municipalities participation by completing worksheets, surveys, and forms. As stated above in the community profile section of this hazard mitigation plan, of the communities in Calvert County, two are incorporated municipalities and seven are unincorporated communities labelled as Town Centers.

Table 9 - Municipality Worksheets, Surveys, and Forms Participation

Calvert County HMP Worksheets, Surveys, and Forms Participation				
Municipality/Town Centers	**Capability Assessment Survey**	**Risk Assessment Hazard Identification and Risk Evaluation Worksheet**	**NFIP**	**Hazard Mitigation Opportunity Form Review and Updates**
Town of Chesapeake Beach	X	X	X	-
Town of North Beach	X	X	X	-

All of the municipalities in Calvert County adopted the 2017 Calvert County Hazard Mitigation Plan as the municipal hazard mitigation plan. The goal of the Calvert County Local Planning Team is to have 100% participation by municipalities in adopting the 2023 Calvert County Hazard Mitigation.

The table above was completed with the most accurate information available at the time of the writing of this Hazard Mitigation Plan Update. Since the writing of this plan, some of the municipalities listed above have provided information to Calvert County which updates their participation status.

4. Risk Assessment

4.1. Update Process Summary

A key component to reducing future loss is to first have a clear understanding of what the current risks are and what steps may be taken to lessen their threat. The development of the risk assessment is a critical first step in the entire mitigation process, as it is an organized and coordinated way of assessing potential hazards and risks. The risk assessment identifies the effects of both natural and human-caused hazards and describes each hazard in terms of its frequency, severity, and county impact. Numerous hazards were identified as part of the process.

A risk assessment evaluates threats associated with a specific hazard and is defined by probability and frequency of occurrence, magnitude, severity, exposure, and consequences. The Calvert County risk assessment provides in-depth knowledge of the hazards and vulnerabilities that affect Calvert County and its municipalities. This document uses an all-hazards approach when evaluating the hazards that affect the county and the associated risks and impacts each hazard presents.

This risk assessment provides the basic information necessary to develop effective hazard mitigation/prevention strategies. Moreover, this document provides the foundation for the Calvert County Emergency Operations Plan (EOP), local EOPs and other public and private emergency management plans.

The Calvert County risk assessment is not a static document, but rather, is a biennial review requiring periodic updates. Potential future hazards include changing technology, new facilities and infrastructure, dynamic development patterns and demographic and socioeconomic changes into or out of hazard areas. By contrast, old hazards, such as brownfields and landfills, may pose new threats as county conditions evolve.

Using the best information available and geographic information systems (GIS) technologies, the county can objectively analyze its hazards and vulnerabilities. Assessing past events is limited by the number of occurrences, scope and changing circumstances. For example, ever-changing development patterns in Maryland have a dynamic impact on traffic patterns, population density and distribution, storm water runoff and other related factors. Therefore, limiting risk assessment to past events is myopic and inadequate.

The Calvert County Local Planning Team (LPT) reviewed and assessed the change in risk for all natural and human-caused hazards identified in the 2017 hazard mitigation plan. The mitigation planning team then identified hazards that were outlined within the Maryland Hazard Mitigation Plan but not included in the 2023 Calvert County Hazard Mitigation Plan that could impact Calvert County. The team utilized the hazard identification and risk evaluation worksheet developed for use with hazard mitigation plan updates.

The Calvert County Steering Committee met with municipalities and provided guidance on how to complete the municipal hazard identification and risk evaluation worksheet. Both municipalities in Calvert County returned a completed worksheet. This information was combined with the county information to develop an overall list of hazards that would need to be profiled.

Once the natural and human-caused hazards were identified and profiled, the local planning team then completed a vulnerability assessment for each hazard. An inventory of vulnerable assets was completed utilizing GIS data and local planning team knowledge. The team used the most recent Calvert County assessment data to estimate loss to particular hazards. Risk factors were then assessed to each of the twenty-eight hazards utilizing the hazard prioritization matrix. This assessment allows the county and its municipalities to focus on and prioritize local mitigation efforts on areas that are most likely to be damaged or require early response to a hazard event.

4.2. Hazard Identification

4.2.1. Presidential and Gubernatorial Disaster Declarations

Table 10 – Presidential & Gubernatorial Disaster Declaration contains a list of all Presidential and Gubernatorial disaster declarations that have affected Calvert County and its municipalities from 1996 through 2023, according to the Maryland Department of Emergency Management.

Table 10 - Presidential & Gubernatorial Disaster Declaration

Presidential Disaster Declarations and Gubernatorial Declarations and Proclamations		
Date	**Hazard Event**	**Action**
01/06/1996 – 01/12/1996	Blizzard	Major Disaster Declaration
09/16/1999 – 09/20/1999	Hurricane Floyd	Major Disaster Declaration
01/25/2000 – 01/30/2000	Winter Storms	Major Disaster Declaration
04/28/2002	Tornado	Major Disaster Declaration
02/14/2003 – 02/23/2003	Snowstorm	Emergency Declaration
09/18/2003 – 09/29/2003	Hurricane Isabel	Major Disaster Declaration
08/26/2011 – 09/05/2011	Hurricane Irene	Major Disaster Declaration
10/26/2012 – 11/04/2012	Hurricane Sandy	Emergency Declaration
01/20/2020 – 05/11.2023	Covid-19	Emergency Declaration
08/03/2023 – 08/04/2023	Tropical Storm Isaias	Major Disaster Declaration
Source: FEMA, 2023		

4.2.2. Summary of Hazards

The Calvert County LPT was provided the Maryland Standard List of Hazards to be considered for evaluation in the 2023 HMP Update. Following a review of the hazards considered in the 2017 HMP and the standard list of hazards, the local planning team decided that the 2023 plan should identify, profile, and analyze twenty-eight hazards. The list below contains the hazards that have the potential to impact Calvert County as identified through previous risk assessments, the Calvert County Hazard Vulnerability Analysis and input from those who participated in the 2023 HMP update. Hazard profiles are included in Section 4.3 for each of these hazards.

Identified Natural Hazards

Coastal Erosion

Coastal erosion is a natural coastal process in which sediment outflow exceeds sediment inflow. This movement of sediment can be caused by large storms, flooding, strong wave action, sea level rise, or human activities. Coastal erosion can take place very slowly, with the shoreline shifting only inches to a foot per year (chronic erosion); or more rapidly, with changes exceeding ten feet per year due to a single storm or series of storms (episodic erosion).

Drought

Drought is defined as a deficiency of precipitation experienced over an extended period of time, usually a season or more. Droughts increase the risk of other hazards, like wildfires, flash floods, and landslides or debris flows. This hazard is of particular concern in Maryland due to the prevalence of farming and other water-dependent industries, water dependent recreation uses, and residents who depend on wells for drinking water.

Extreme Temperature

Extreme heat often results in the highest number of annual deaths of all weather-related hazards. In most of the United States, extreme heat is defined as a long period (2 to 3 days) of high heat and humidity with temperatures above 90 degrees. Extremely cold air comes every winter in at least part of the country and affects millions of people across the United States. The arctic air, together with brisk winds, can lead to dangerously cold wind chill values. People exposed to extreme cold are susceptible to frostbite and hypothermia in a matter of minutes.

Flooding/Flash Flooding

Flooding is the temporary condition of partial or complete inundation of normally dry land, and it is the most frequent and costly of all-natural hazards in Maryland. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often along mountain streams and in urban areas where much of the ground is covered by impervious surfaces.

Hailstorm

Hailstorms occur when ice crystals form within a low-pressure front due to the rapid rise of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight, they fall as precipitation in the form of balls or irregularly shaped masses of ice greater than 0.75 inches in diameter. Hailstorms can cause significant damage to homes, vehicles, livestock, and people.

Hurricane/Tropical Storm

Hurricanes, tropical storms, and nor'easters are classified as cyclones and are any closed circulation developing around a low-pressure center in which the winds rotate counterclockwise (in the Northern Hemisphere) and whose diameter averages 10-30 miles across. Potential threats from hurricanes include powerful winds, heavy rainfall, storm surges, coastal and inland flooding, rip currents, tornadoes, and landslides. The Atlantic hurricane season runs from June 1 to November 30.

Invasive Species

An invasive species is a species that is not indigenous to the ecosystem under consideration and whose introduction causes or is likely to cause economic, environmental, or human harm. These species can be any type of organism: plant, fish, invertebrate, mammal, bird, disease, or pathogen.

Landslide

In a landslide, masses of rock, earth or debris move down a slope. Landslides can be caused by a variety of factors, including earthquakes, storms, fire, and human modification of land. Areas that are prone to landslide hazards include previous landslide areas, areas on or at the base of slopes, areas in or at the base of drainage hollows, developed hillsides with leach field septic systems, and areas recently burned by forest or brush fires.

Pandemic and Infectious Disease

A pandemic is a global outbreak of disease that occurs when a new virus emerges in the human population, spreading easily in a sustained manner, and causing serious illness. An epidemic describes a smaller scale infectious outbreak, within a region or population, that emerges at a disproportionate rate. Infectious disease outbreaks may be widely dispersed geographically, impact large numbers of the population, and could arrive in waves lasting several months at a time.

Radon Exposure

Radon is a radioactive gas produced by the breakdown of uranium in soil and rock that can lead to lung cancer in people exposed over a long period of time. Most exposure comes from breathing in radon gas that enters homes and buildings through foundation cracks and other openings. According to the DEP, approximately 40% of Maryland homes have elevated radon levels.

Subsidence/Sinkhole

Land subsidence is a gradual settling or sudden sinking of the ground surface due to the movement of subsurface materials. A sinkhole is a subsidence feature resulting from the sinking of surficial material into a pre-existing subsurface void. Subsidence and sinkholes are geologic hazards that can impact roadways and buildings and disrupt utility services. Subsidence and sinkholes are most common in areas underlain by limestone and can be exacerbated by human activities such as water, natural gas, and oil extraction.

Tornadoes/Windstorm

A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. About 1,250 tornadoes hit the U.S. each year, with about sixteen occurring in Maryland. Damaging winds exceeding 50-60 miles per hour can occur during tornadoes, severe thunderstorms, winter storms, or coastal storms. These winds can have severe impacts on buildings, pulling off the roof covering, roof deck, or wall siding and pushing or pulling off the windows.

Wildfire

A wildfire is an unplanned fire that burnt in a natural area. Wildfires can cause injuries or death and can ruin homes in their path. Wildfires can be caused by humans or lightning, and can happen anytime, though the risk increases in period of little rain. In Maryland, 98% of wildfires are caused by people.

Winter Storm

A winter storm is a storm in which the main types of precipitation are snow, sleet, or freezing rain. A winter storm can range from a moderate snowfall or ice event over a period of a few hours to blizzard conditions with wind-driven snow that lasts for several days. Most deaths from winter storms are not directly related to the storm itself, but result from traffic accidents on icy roads, medical emergencies while shoveling snow, or hypothermia from prolonged exposure to cold.

Identified Human Caused Hazards

Civil Disturbance

A civil disturbance is defined by FEMA as a civil unrest activity (such as a demonstration, riot, or strike) that disrupts a community and requires intervention to maintain public safety.

Dam Failure

Dam failure is the uncontrolled release of water (and any associated wastes) from a dam. This hazard often results from a combination of natural and human causes, and can follow other hazards such as hurricanes, earthquakes, and landslides. The consequences of dam failures can include property and environmental damage and loss of life.

Emergency Services Shortages

Emergency medical services (EMS) and fire department services play a crucial role in the emergency response system, and the functionality of these emergency services directly impacts many of the other hazard profiles in this report. Both EMS and fire services face challenges from lack of funding and lower rates of volunteerism.

Environmental Hazards/Hazardous Materials

Environmental hazards are hazards that pose threats to the natural environment, the built environment and public safety through the diffusion of harmful substances, materials, or products. Environmental hazards include the following:

- Hazardous Material Releases: at fixed facilities or as such materials are in transit and including toxic chemicals, infectious substances, biohazardous waste and any materials that are explosive, corrosive, flammable, or radioactive (PL 1990-165, § 207(e)).
- Air or Water Pollution; the release of harmful chemical and waste materials into water bodies or the atmosphere, for example.(National Institute of Health Sciences, July 2009; Environmental Protection Agency, Natural Disaster PSAs, 2009).
- Superfund Facilities: hazards originating from abandoned hazardous waste sites listed on the National Priorities List (Environmental Protection Agency, National Priorities List, 2009).
- Manure Spills: involving the release of stored or transported agricultural waste, for example (Environmental Protection Agency, Environmental Impacts of…, 1998).
- Product Defect or Contamination; highly flammable or otherwise unsafe consumer products and dangerous foods (Consumer Product Safety Commission, 2003).

Hazardous material releases can contaminate air, water, and soils and have the potential to cause injury or death. Dispersion can take place rapidly when transported by water and wind. While often accidental, releases can occur as a result of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, these incidents are known as secondary events.

Nuclear Incidents

Nuclear explosions can cause significant damage and casualties from blast, heat, and radiation. The primary concern following a nuclear accident or nuclear attack is the extent of radiation, inhalation, and ingestion of radioactive isotopes which can cause acute health effects (e.g. death, burns, severe impairment), chronic health effects (e.g. cancer), and psychological effects.

Opioid Epidemic

An opioid epidemic is the rapid increase in the use of prescription and non-prescription opioid drugs in the United States beginning in the late 1990s and continuing throughout the first two decades of the 2000s. Opioids are a diverse class of moderately strong painkillers, including oxycodone, hydrocodone, and a very strong painkiller, fentanyl, which is synthesized to resemble other opiates such as opium-derived morphine and heroin. The potency and availability of these substances, despite their high risk of addiction and overdose, have made them popular both as formal medical treatments and as recreational drugs. Due to their sedative effects on the part of the brain which regulates breathing, opioids in high doses present the potential for respiratory depression and may cause respiratory failure and death.

The State of Maryland, along with other states in the nation has enact-ed legislation to curb the prescription and distribution of these drugs to try to prevent addiction rising from abuse as a painkiller. This includes but is not limited to restrictions to prescribing to minors, quantity limits, a prescription database with entry requirements and other limits to its availability.

Terrorism/Cyberterrorism Incidents

Terrorism is use of force or violence against persons or property with the intent to intimidate or coerce. Acts of terrorism include threats of terrorism; assassinations; kidnappings; hijackings; bomb scares and bombings; cyber-attacks (computer-based); and the use of chemical, biological, nuclear, and radiological weapons. Cyber-attacks have become an increasingly pressing concern. Cyberterrorism refers to acts of terrorism committed using computers, networks, and the internet. The most widely cited definition comes from Denning's Testimony before the Special Oversight Panel on Terrorism: "Cyberterrorism…is generally understood to mean unlawful attacks and threats of attack against computers, networks, and the information stored therein when done to intimidate or coerce a government or its people in furtherance of political or social objectives. Further, to qualify as cyberterrorism, an attack should result in violence against persons or property, or at least cause enough harm to generate fear".

Transportation Accidents

Transportation accidents are technological hazards involving the nation's system of land, sea, and air transportation infrastructure. A flaw or breakdown in any component of this system can and often does result in a major disaster involving loss of life, injuries, property and environmental damage, and economic consequences.

Utility Interruption

Utility interruption hazards are hazards that impair the functioning of important utilities in the energy, telecommunications and public works and information network sectors. Utility interruption hazards include the following:

- Geomagnetic Storms; including temporary disturbances of the Earth's magnetic field resulting in disruptions of communication, navigation, and satellite systems (National Research Council et al., 1986).
- Fuel or Resource Shortage; resulting from supply chain breaks or secondary to other hazard events, for example.
- Electromagnetic Pulse; originating from an explosion or fluctuating magnetic field and causing damaging current surges in electrical and electronic systems (Institute for Telecommunications Sciences, 1996).
- Information Technology Failure; due to software bugs, viruses, or improper use (Rainer Jr., et al, 1991).
- Ancillary Support Equipment; electrical generating, transmission, system-control, and distribution-system equipment for the energy industry (Hirst & Kirby, 1996).
- Public Works Failure; damage to or failure of highways, flood control systems, deep-water ports and harbors, public buildings, bridges, dams, for example (United States Senate Committee on Environment and Public Works, 2009).
- Telecommunications System Failure; Damage to data transfer, communications, and processing equipment, for example (FEMA, 1997)
- Transmission Facility or Linear Utility Accident; liquefied natural gas leakages, explosions, facility problems, for example (United States Department of Energy, 2005)
- Major Energy, Power, Utility Failure; interruptions of generation and distribution, power outages, for example (United States Department of Energy, 2000).

4.2.3. Climate Change

Impacts of Climate Change on Identified Hazards

Humans have become the dominant species on Earth and our society and influence is globalized. Human activity such as the large-scale consumption of fossil fuels and de-forestation has caused atmospheric carbon dioxide concentrations to significantly increase and a notable diversity of species to go extinct. The result is rapid climate change unparalleled in Earth's history and an extinction event approaching the level of a mass extinction (Barnosky et al., 2011; Wake & Vredenburg, 2008). The corresponding rise of average atmospheric temperatures is intensifying many natural hazards, and further threatening biodiversity. The effects of climate change on these hazards are expected to intensify over time as temperatures continue to rise, so it is prudent to be aware of how climate change is impacting natural hazards.

The most obvious change is in regard to extreme temperature. As average atmospheric temperatures rise, extreme high temperatures become more threatening, with record high temperatures outnumbering record low temperatures 2:1 in recent years. As climate change intensifies, it is expected that the risk of extreme heat will be amplified whereas the risk of extreme cold will be attenuated. Some studies show increased insect activities during a similar rapid warming event in Earth's history. Other studies make projections that with the warming temperatures and lower annual precipitation that are expected with climate change, there will be an expansion of the suitable climate for mosquitos, potentially increasing the risk of infectious disease.

Climate change is likely to increase the risk of droughts (Section 4.3.2). Higher average temperatures mean that more precipitation will fall as rain rather than snow, snow will melt earlier in the spring, and evaporation and transpiration will increase. Along with the prospect of decreased annual precipitation, the risk of hydrological and agricultural drought is expected to increase (Sheffield & Wood, 2008). Correspondingly this will impact wildfires. Drought is accompanied by drier soils and forests, resulting in an elongated wildfire season and more intense and long-burning wildfires (Pechony & Shindell, 2010). However, the southwest United States is at a greater risk of this increased drought and wildfire activity than Calvert County in the Eastern United States.

While it may seem counterintuitive considering the increased risk of drought, there is also an increased risk of flooding associated with climate change (Section 4.3.5). Warmer temperatures mean more precipitation will fall as rain rather than snow. Combined with the fact that warmer air holds more moisture, the result is heavier and more intense rainfalls and dam and levee failures. Similarly, winter storms are expected to become more intense, if possibly less frequent. Climate change is also expected to result in more intense hurricanes and tropical storms. With the rise of atmospheric temperatures, ocean surface temperatures are rising, resulting in warmer and more moist conditions where tropical storms develop (Stott et al., 2010). A warmer ocean stores more energy and is capable of fueling stronger storms. It is projected that the Atlantic hurricane season is elongating, and there will be more category 4 and 5 hurricanes than before (Trenberth, 2010). This increase in tropical storms and hurricanes will directly impact Calvert County and will result in more flooding events impacting the coastal areas of the county.

Sea level rise will also adversely impact Calvert County as the rate of climate change increases. With warmer global temperatures and warmer oceans, glaciated areas of the plant and global ice sheets will melt and fall into bodies of water. This will result in a net increase in sea level, which is critical to low lying areas of the planet, including Calvert County, Maryland.

Climate change is contributing to the introduction of new invasive species (Section 4.3.6). As maximum and minimum seasonal temperatures change, non-native species are able to establish themselves in previously inhospitable climates where they have a competitive advantage. This may shift the dominance of ecosystems in the favor of non-native species, contributing to species loss and the risk of extinction.

Socially vulnerable populations in Calvert County will be at increasing vulnerability to natural hazards and this will increase with the risk of climate change. Currently, Calvert County has a very low social vulnerability index (SVI) as published from the Centers for Disaster Control and Prevention (CDC)/ Agency for Toxic Substances and Disease Registry (ATSDAR) Social Vulnerability Index (SVI). This SVI could increase if climate change is not mitigated. The social vulnerability for natural hazards is listed as low by the same analysis but this is likely to increase with the effects of climate change.

This type of sudden global change is novel to humanity. Despite the myriad of well thought out research, there is still much uncertainty surrounding the future of the Earth. All signs point to the intensification of the hazards mentioned above, especially if human society and individuals do not make swift and significant changes combat species losses. Climate change will affect the entire list of hazards that follow in this hazard mitigation, and each of those impacts will be unique.

4.3. Hazard Profiles

4.3.1. Coastal Erosion

4.3.1.1 Location and Extent

Coastal erosion is a natural hazard that has a unique impact on Calvert County. Coastal erosion in relation to Calvert County is the eroding or removal of rock, sediment, and beach materials along the coasts of the county. The county deals with coastal erosion in cliffs and beaches along the coasts with the Chesapeake Bay to the east and the Patuxent River to the west. There are many areas of particular concern for Calvert County and those include the towns of Chesapeake Beach and North Beach, the Calvert County cliffs areas, and the areas around Solomons in the southern part of the county.

4.3.1.2 Range of Magnitude

Coastal erosion in Maryland and Calvert County is measured in the number of feet of coastal material (sand, rock, sediment) lost each year to erosion. There are no major scales or ranges for coastal erosion that are used across the United States as a national standard, similar to other natural hazards.

4.3.1.3 Past Occurrence

Coastal erosion occurs every year, with varying degrees of erosion each year. Past coastal erosion has been recorded as fast as eight feet per year in Maryland and Calvert County. Most of the coastal erosion in Calvert County occurs at a slower pace than eight feet per year, but cliff erosion (also coastal for Calvert County) can occur more rapidly. No records of specific coastal erosion events are recorded, as it is an event that occurs continuously every year unless remediated and acted upon.

Common cliff erosion rates in Calvert County are moderate and are anywhere between 0 feet and 4 feet per year. This information is reported by the Maryland Department of Natural Resources. The MDNR states that approximately 65% of the shoreline in Maryland has low to moderate erosion and the remaining shoreline has moderate to high erosion (MDNR, Shore Erosion Control Guidelines for Waterfront Property Owners, 2008). Based on information from the second edition of the Shore Erosion Control Guidelines for Waterfront Property Owners, 30 miles of shore stabilization projects occur every year in Maryland.

4.3.1.4 Future Occurrence

Coastal erosion is likely to continue in Calvert County, as beaches and cliffs continue to migrate inland from the coast. Climate change, contributing to sea level rise, will increase the amount of coastal erosion and migration in Calvert County. Future occurrence of coastal erosion can be postponed and mitigated with different projects including but not limited to the addition of new beach and coast material and dune construction along coastal areas. This will not stop coastal erosion but could slow down the process and replace material that has already been lost. With no remediation, future occurrences are likely to continue or increase in pace.

Climate change significantly exacerbates coastal erosion through various mechanisms. Rising global temperatures lead to the melting of polar ice caps and glaciers, causing sea levels to rise. This rise in sea levels intensifies the force of waves and storm surges, accelerating erosion along coastlines. Additionally, climate change contributes to extreme weather events, including more frequent and severe storms, hurricanes, and typhoons. These events bring intense rainfall and powerful winds, further eroding coastal areas. Overall, climate change acts as a catalyst for coastal erosion, posing significant threats to coastal communities, ecosystems, and infrastructure.

4.3.1.5 Vulnerability Assessment

Areas directly adjacent to the coasts in Calvert County are at an increased risk of coastal erosion. Low lying areas of Calvert County, including the towns of Chesapeake Beach and North Beach, could see increased property loss related to coastal erosion. There are approximately 624 address points in the Town of Chesapeake Beach and 302 address points in the Town of North Beach that are within 500 feet of the shoreline. These locations are more vulnerable to coastal erosion in the short-term, while those areas that are further inland would be more vulnerable in the long-term.

Figure 5 – Calvert County Coastal Erosion Vulnerable Assets illustrates the countywide distribution of address points and buildings that are at potential vulnerability to coastal erosion. *Figure 6 – Calvert County Coastal Erosion Vulnerable Assets – Towns* illustrates the number of vulnerable assets around Chesapeake Beach and North Beach.

Based on Calvert County GIS information, there are currently 5,859 address points that fall within 500 feet of the coastlines. Not all of those locations are residential locations, but all of those locations would be vulnerable to increased coastal erosion.

There are four community lifeline locations that are within 500 feet of the coasts, especially near the towns of Chesapeake Beach and North Beach. These four community lifelines are outlined in the table below:

Community Lifelines in 500 feet of coasts	
Facility Name	**Facility Type**
Chesapeake’s Bounty	Grocery Store
Chesapeake Beach Town Hall	Municipal Building
Fast Stop – Citgo	Gas Station
North Beach Volunteer Fire Department	Fire Department

Future development along coastal areas in Calvert County is carefully controlled and planned. Development in high risk areas, including along cliffs, is strictly reviewed. Future development along more gradual sections of the Calvert County coast is not expected on a large scale, but an increase of addresses points in those areas could occur.

Development in the towns of Chesapeake Beach and North Beach are also highly reviewed and regulated in the vulnerability area, so significant development in those areas in the municipalities is unlikely, but not impossible.

Coastal erosion remediation projects are currently underway in Calvert County, including a project near Breezy Point Beach and Campground that began on July 12th, 2023. This project consisted of adding sand to the areas around the shoreline of Breezy Point Beach and Campground.

Impact of coastal erosion on historic properties in Calvert County

Based on the historic properties located in Calvert County, nine would be at an increased vulnerability to coastal erosion. The following locations are within 500ft of the coastline as outlined by NOAA: Chesapeake Beach Railway Station, Cove Point Lighthouse, Drum Point Lighthouse, Grahame House, J. C. Lore Oyster House, La Veille, Morgan Hill Farm, Patterson Archaeological and Historic District, and the Preston-on-the-Patuxent.

Only one of these properties is located in an incorporated municipality and that is Chesapeake Beach Railway Station, located in the town of Chesapeake Beach.

As seen in *Table 2 – Population Change in Calvert County*, The Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. Based on this information, it can be speculated that these municipalities may have an increased vulnerability to coastal erosion, since 2010, due to the increase in population.

Coastal erosion impacts socially vulnerable populations by exacerbating existing inequalities. Low-income communities, often situated in vulnerable coastal areas, face heightened risks of displacement, loss of homes, and livelihoods. Limited access to resources, inadequate infrastructure, and a lack of financial resilience amplify the challenges they encounter.

The most common land use that could be impacted by coastal erosion in Calvert County is residential land, specifically low to medium density residential. Also, undeveloped portions of the boundary with the Chesapeake Bay and the Patuxent River could see coastal erosion. These areas are primarily forested or cliffs.

Coastal erosion may pose a threat to pipeline and the water systems in Calvert County. As coastlines erode, the integrity of water supply infrastructure can be compromised, leading to increased salinity in freshwater sources. Pipelines, often laid near coastal areas, face the risk of exposure and damage. Erosion may undermine the stability of pipeline foundations, causing leaks and disruptions in water supply. Additionally, sedimentation resulting from erosion can clog pipelines, reducing their efficiency and necessitating costly maintenance. The combination of saltwater intrusion and pipeline vulnerability amplifies the potential for contamination and service interruptions, impacting both water quality and the reliability of essential services for coastal communities.

Coastal erosion in Calvert County has major effects on natural resources. The Chesapeake Bay, a vital ecosystem, faces shoreline retreat, diminishing critical habitats for marine life. Wetlands, essential for water filtration and biodiversity, suffer erosion-related degradation, impacting the health of the entire ecosystem. Also, the erosion accelerates sedimentation in the Bay, affecting water quality and posing threats to fisheries. As natural buffers erode, the vulnerability of coastal communities to storm surges and flooding increases.

Figure 5 - Calvert County Coastal Erosion Vulnerable Assets

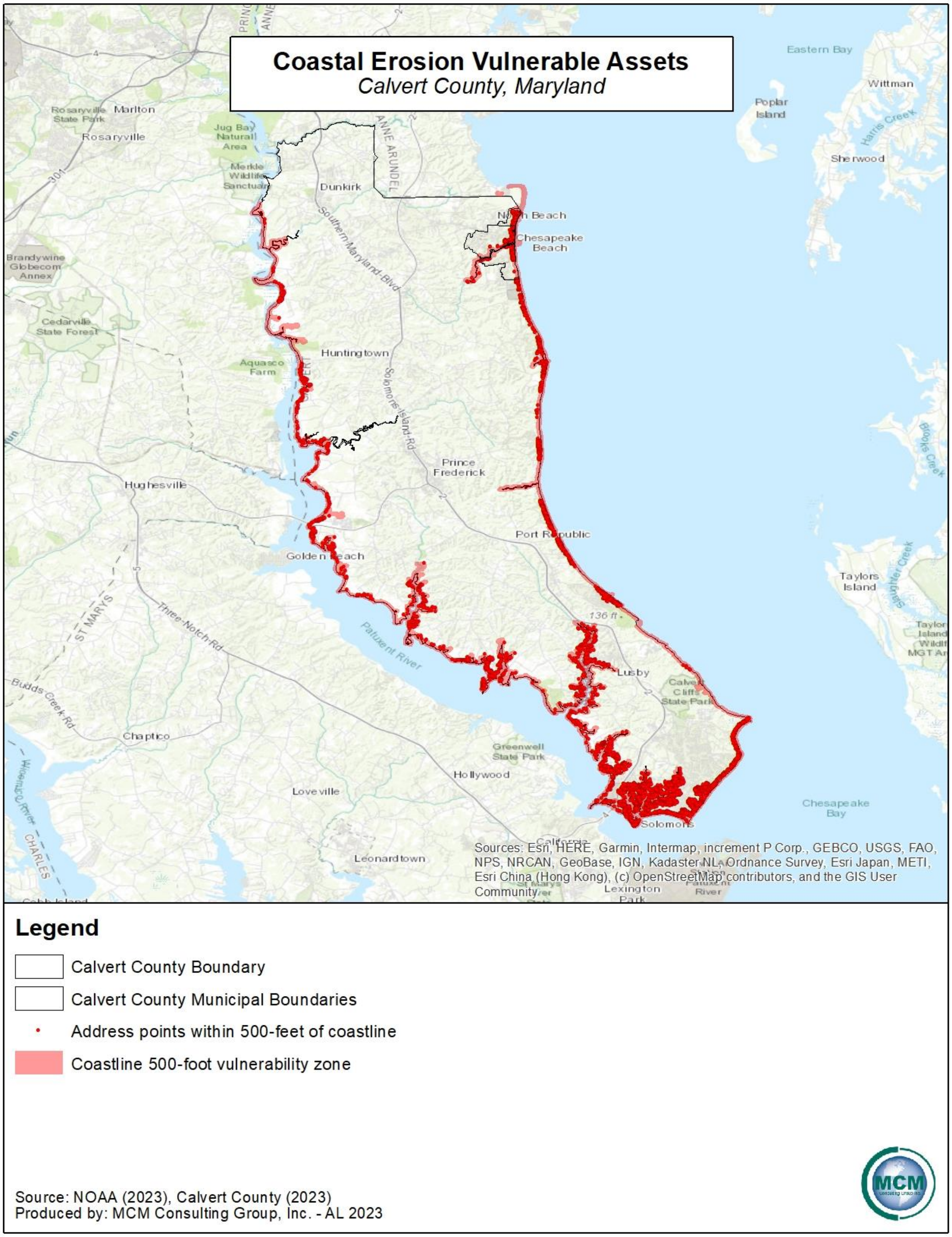
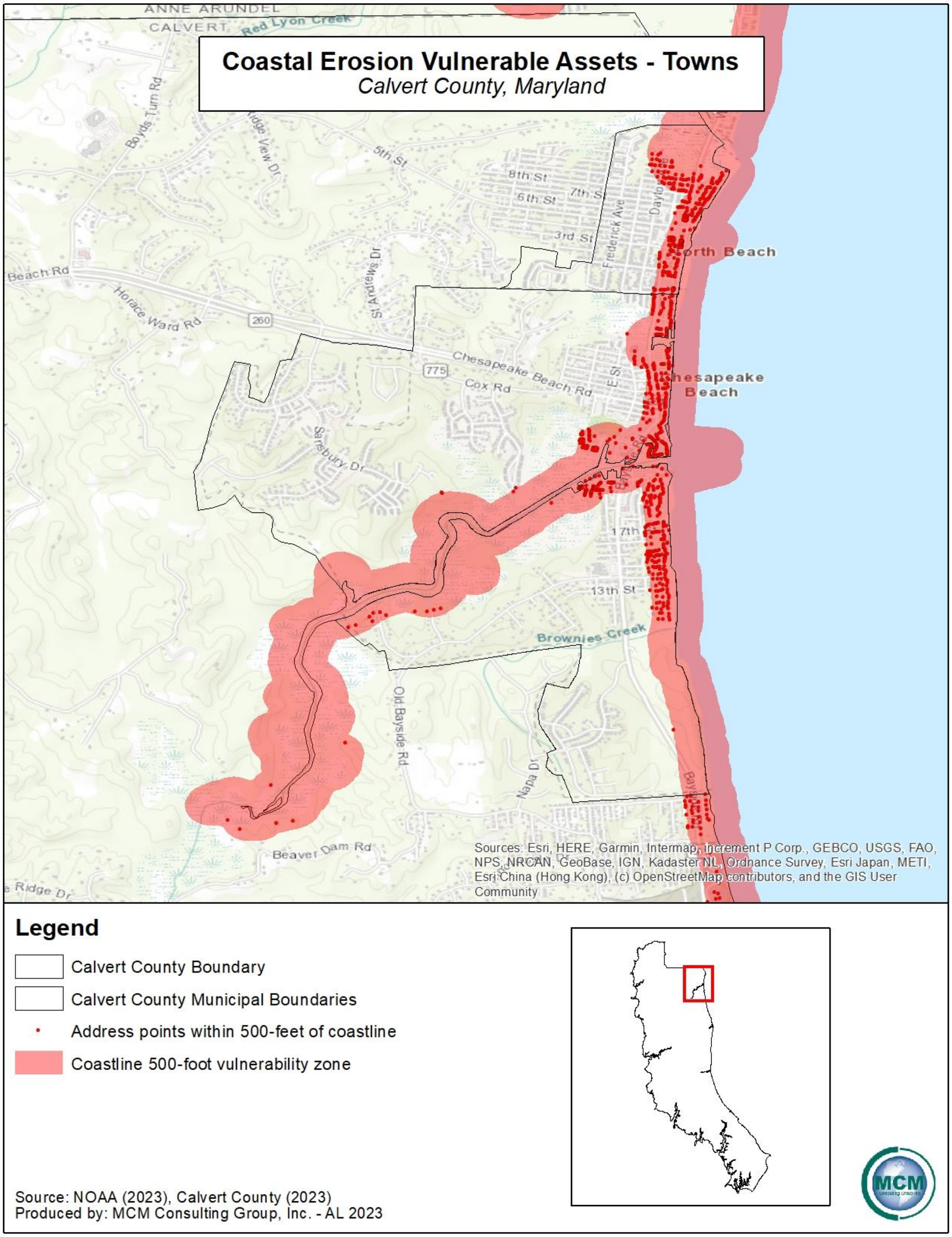


Figure 6 - Calvert County Coastal Erosion Vulnerable Assets – Towns



4.3.2. Drought

4.3.2.1 Location and Extent

While Maryland is generally more water-rich than many U.S. states, the state may experience drought conditions intermittently throughout the calendar year. A drought is broadly defined as a time period of prolonged dryness that contributes to the depletion of ground and surface water. Droughts are regional climatic events, so when such an event occurs in Calvert County, impacts are not restricted to the county and are often more widespread. The spatial extent of the impacted area can range from localized areas in Maryland to the entire Mid-Atlantic region.

There are three types of droughts:

Meteorological Drought – A deficiency of moisture in the atmosphere compared to average conditions. Meteorological drought is defined by the duration of the deficit and degree of dryness and is often associated with below average rainfall. Depending on the severity of the drought, it may or may not have a significant impact on agriculture and the water supply.

Agricultural Drought – A drought inhibiting the growth of crops, due to a moisture deficiency in the soil. Agricultural drought is linked to meteorological and hydrologic drought.

Hydrologic Drought – A prolonged period without rainfall that has an adverse effect on streams, lakes, and groundwater levels, potentially impacting agriculture.

Droughts are often the leading contributing factor to wildfires, as they leave areas with little to no moisture. Droughts can have adverse effects on farms and other water-dependent industries resulting in local economic loss. Areas of extensive agriculture use are particularly vulnerable to drought; 25,152 acres of Calvert County, or roughly 11% of the 220,800 total land acreage, make up farmland (United States Department of Agriculture [USDA], 2017 Census). The total number of farms for Calvert County is 280 and the average acreage for farms in Calvert County is 90 acres. Calvert County ranks 22nd of twenty-three counties in the state for agricultural production, totaling over $6.32 million annually. Agricultural production from crops, including nursery and greenhouse crops, accounts for more than $5 million in commerce annually. Production from livestock, poultry, and their products accounts for $621 thousand annually. Acreage for farming has decreased since the 2012 USDA Census when there was a reported total of 32,901 farming and drought vulnerable acres.

4.3.2.2 Range of Magnitude

The average annual precipitation of 49.26 in. (rain) occurs primarily during the spring and summer months. This value is derived from an average of ten years of mean annual precipitation data for Calvert County. Rural farming areas of Calvert County are most at risk when a drought occurs. A drought can create a significant financial burden for the community. Approximately 97% of Calvert County farms are family-owned and operated. Additionally, 50% of the county farmland use is devoted to crop cultivation and 8% to livestock and poultry. Wildfires are often the most severe secondary effect associated with drought. Wildfires can devastate wooded and agricultural areas, structures near high wildfire loads, and farm production facilities, and threaten natural resources. Prolonged drought conditions can have a lasting impact on the economy and can cause major ecological changes, such as increases in scrub growth, flash flooding, and soil erosion.

Long-term water shortages during severe drought conditions can have a significant impact on agribusiness, public utilities, and other industries reliant on water for production services. Calvert County also has a growing agritourism business that would be threatened by long-term drought.

Local municipalities may, with the approval of the Maryland Department of the Environment, implement local water rationing. These individual water rationing plans will require specific limits on individual water consumption to achieve significant reductions in use. Under mandatory water usage restrictions imposed by the state and/or local municipalities, procedures are provided for granting of variances to consider individual hardships and economic dislocations. *Table 11 – Drought Preparation Phases* shows the FEMA-defined levels of drought severity along with suggested actions, requests, and goals.

Table 11 - Drought Preparation Phases

Drought Preparation Phases				
Phase	**General Activity**	**Actions**	**Request**	**Goal**
Drought Watch	Early stages of planning and alert for drought possibility.	Increased water monitoring, awareness, and preparation for response among government agencies, public water suppliers, water users, and the public.	Voluntary water conservation.	Reduce water use by 5%.
Drought Warning	Coordinate a response to imminent drought conditions and potential water shortages.	Reduce shortages – relieve stressed sources, develop new sources if needed.	Continue voluntary water conservation, impose mandatory water use restrictions if needed.	Reduce water use by 10 – 15%.

Drought Preparation Phases				
Phase	**General Activity**	**Actions**	**Request**	**Goal**
Drought Emergency	Management of operations to regulate all available resources and respond to emergency.	Support essential and high priority water uses and avoid unnecessary uses.	Possible restrictions on all nonessential water uses.	Reduced water use by 15%.
Source: FEMA				

The state uses different parameters to assess drought conditions:

- Stream flows (compared to benchmark records)
- Precipitation (measured as the departure from normal, thirty-year average precipitation)
- Groundwater elevations in a number of counties (comparing to past month, past year, and historic records)
- Soil moisture via the Palmer Drought Index as seen in *Table 12 – Palmer Drought Severity Index*, which is a soil moisture algorithm calibrated for relatively homogenous regions which measures dryness based on recent precipitation and temperature.

Table 12 - Palmer Drought Severity Index

Palmer Drought Severity Index (PDSI)	
Severity Category	**PDSI Value**
Extremely Wet	4.0 or more
Very Wet	3.0 to 3.99
Moderately Wet	2.0 to 2.99
Slightly Wet	1.0 to 1.99
Incipient Dry Spell	0.5 to 0.99
Near Normal	0.49 to -0.49
Incipient Dry Spell	-0.5 to -0.99
Mild Drought	-1.0 to -1.99
Moderate Drought	-2.0 to -2.99
Severe Drought	-3.0 to -3.99
Extreme Drought	-4.0 or less

The effects of a drought can be far-reaching both economically and environmentally. Economic impacts include reduced productivity of aquatic resources, mandatory water use restrictions, well failures, cutbacks in industrial production, agricultural losses, and limited recreational opportunities. Environmental impacts of drought include the following: *Table 13 – Economic and Environmental Impacts of Drought Events* qualifies the potential economic and environmental impacts from a drought event.

Table 13 - Economic and Environmental Impacts of Drought Events

Economic and Environmental Impacts of Drought Events	
Economic	**Environmental**
- Reduced productivity of aquatic resources - Mandatory water use restrictions - Well failures - Cutbacks in industrial production - Agricultural losses - Limited recreational opportunities	- Hydrologic effects - Adverse effects on animal populations - Damage to plant communities - Increased number and severity of fires - Reduced soil quality - Air quality effects - Loss of quality in landscape

4.3.2.3 Past Occurrence

The Maryland Department of the Environment maintains the most comprehensive data on drought occurrences across the state. Descriptions of drought status categories (i.e., watch, warning, and emergency) are included in the "Range of Magnitude" section above. The declared drought status from 1980 to 2021 is shown in *Table 14 – Past Drought Events in Calvert County*.

The National Oceanic and Atmospheric Administration (NOAA) has archived records showing extreme droughts for the state in 1931 and a prolonged event in the 1960s as seen in *Figure 7 – Maryland Palmer Drought Index 1900 – 1999*.

Based on the county's more recent disaster history and other drought occurrence data, the worst drought event in Calvert County occurred in the summer of 2002.

Table 14 - Past Drought Events in Calvert County

Past Drought Events in Calvert County			
Start Date	**End Date**	**Drought Status**	**Event Duration**
11/7/2000	11/27/2000	D0	20
5/8/2001	5/14/2001	D0	6
5/15/2001	5/28/2001	D1	13
7/24/2001	7/30/2001	D0	6
9/18/2001	9/24/2001	D0	6
10/23/2001	10/29/2001	D0	6
10/30/2001	12/17/2001	D1	48
12/18/2001	3/11/2002	D2	83
3/12/2002	4/29/2002	D3	48
4/30/2002	7/22/2002	D2	83
7/23/2002	8/19/2002	D3	27
8/20/2002	9/2/2002	D4	13
9/3/2002	11/4/2002	D2	62
11/5/2002	11/18/2002	D1	13
11/19/2002	12/16/2002	D0	27

Past Drought Events in Calvert County			
Start Date	**End Date**	**Drought Status**	**Event Duration**
6/28/2005	7/4/2005	D0	6
9/6/2005	9/19/2005	D0	13
9/20/2005	10/10/2005	D1	20
3/14/2006	3/27/2006	D0	13
3/28/2006	4/17/2006	D1	20
4/18/2006	4/24/2006	D0	6
5/9/2006	5/15/2006	D0	6
5/30/2006	6/26/2006	D0	27
8/22/2006	9/4/2006	D1	13
3/13/2007	3/19/2007	D0	6
5/29/2007	6/4/2007	D0	6
6/19/2007	7/9/2007	D0	20
7/10/2007	7/16/2007	D1	6
7/17/2007	8/27/2007	D2	41
8/28/2007	10/1/2007	D1	34
10/2/2007	10/29/2007	D2	27
10/30/2007	11/26/2007	D1	27
11/27/2007	1/14/2008	D2	48
1/15/2008	5/12/2008	D1	118
5/13/2008	5/19/2008	D0	6
8/26/2008	9/8/2008	D0	13
10/21/2008	12/15/2008	D0	55
2/10/2009	3/23/2009	D0	41
3/24/2009	4/20/2009	D1	27
4/21/2009	5/4/2009	D0	13
7/21/2009	8/24/2009	D0	34
6/22/2010	6/28/2010	D0	6
6/29/2010	7/5/2010	D1	6
7/6/2010	7/19/2010	D2	13
7/20/2010	8/23/2010	D1	34
8/24/2010	10/4/2010	D0	41
5/17/2011	6/13/2011	D0	27
6/14/2011	8/15/2011	D1	62
8/16/2011	8/29/2011	D0	13
1/10/2012	3/5/2012	D0	55
3/20/2012	4/9/2012	D0	20
4/10/2012	7/23/2012	D1	104
7/24/2012	8/27/2012	D2	34
8/28/2012	10/29/2012	D1	62
9/10/2013	10/14/2013	D0	34
9/23/2014	1/26/2015	D0	125

Past Drought Events in Calvert County			
Start Date	**End Date**	**Drought Status**	**Event Duration**
9/8/2015	10/5/2015	D0	27
4/19/2016	5/9/2016	D0	20
9/27/2016	10/3/2016	D0	6
11/15/2016	2/27/2017	D0	104
2/28/2017	3/13/2017	D1	13
3/14/2017	3/20/2017	D0	6
6/27/2017	7/31/2017	D0	34
10/24/2017	12/4/2017	D0	41
12/5/2017	2/12/2018	D1	69
2/13/2018	3/26/2018	D0	41
4/10/2018	5/21/2018	D0	41
9/10/2019	9/23/2019	D0	13
9/24/2019	10/14/2019	D1	20
10/15/2019	10/21/2019	D2	6
10/22/2019	10/28/2019	D1	6
10/29/2019	12/16/2019	D0	48
1/21/2020	1/27/2020	D0	6
5/25/2021	5/31/2021	D0	6
11/23/2021	1/3/2022	D0	41
3/8/2022	6/27/2022	D0	111
8/30/2022	10/3/2022	D0	34
12/13/2022	12/19/2022	D0	6
1/17/2023	3/27/2023	D0	69
3/28/2023	7/3/2023	D1	97

Source: United States Drought Monitor, 2023
**Calvert County, MD
The USDM uses a five-category system, labeled Abnormally Dry or D0, (a precursor to drought, not actually drought), and Moderate (D1), Severe (D2), Extreme (D3) and Exceptional (D4) Drought. (United States Drought Monitor, 2023).

Figure 7 - Maryland Palmer Drought Index 1900 – 1999

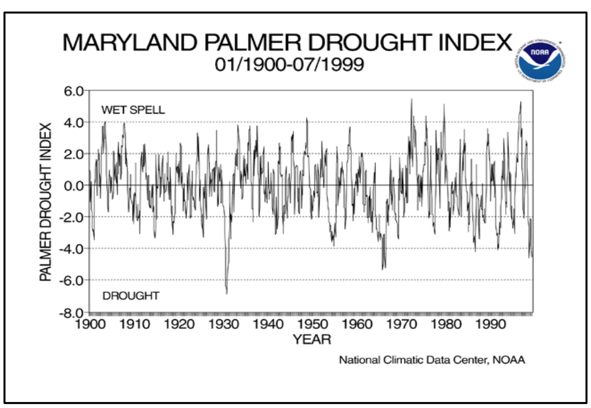
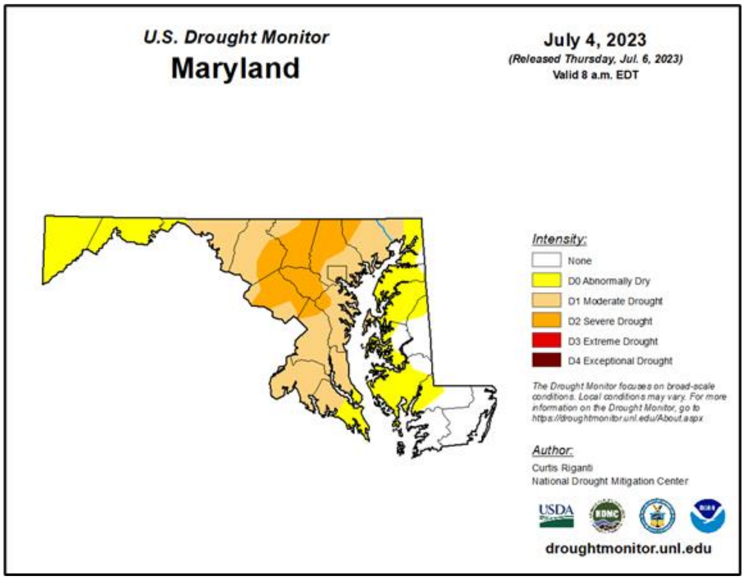


Figure 8 – U.S. Drought Monitor, Maryland illustrates the conditions of drought in Maryland at the time of the report.

Figure 8 - U.S. Drought Monitor, Maryland



4.3.2.4 Future Occurrence

It is difficult to forecast the exact severity and frequency of future drought events. Climate change will lead to increased uncertainty and extremity of climate events. Calvert County experienced severe drought between 5% to 10% of the time between 1895 and 1995 as seen in *Figure 9 – Palmer Drought Severity Index*. This report can be used to make a rough estimate of the future probability of drought in Calvert County, although it does not account for changes introduced by climate change. Drought conditions are expected to become more severe with climate change, as evaporation and transpiration will increase with higher temperatures.

Figure 9 - Palmer Drought Severity Index

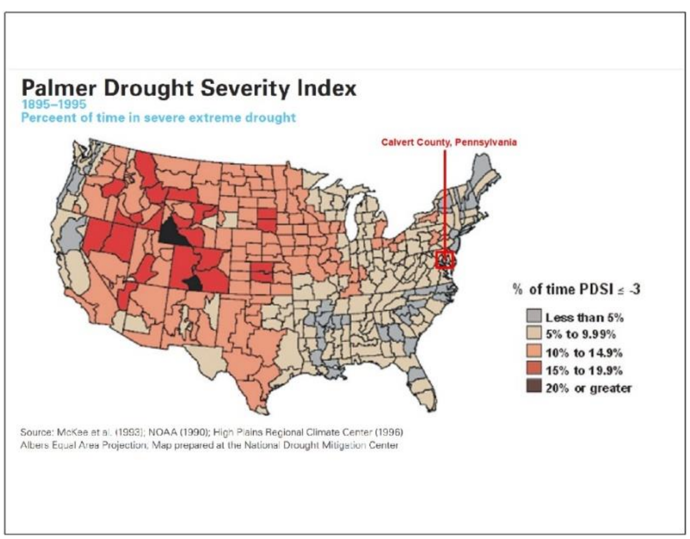


Figure 10 – Current Drought Index for Maryland below shows that Calvert County is currently in D1 – Moderate Drought and D0 – Abnormally Dry status.

The potential for a drought to occur in Calvert County is high. Given the frequency of abnormally dry conditions for Calvert County and its municipalities, the county can reasonably expect to be under a drought watch at least once per year. While some form of drought condition frequently exists in Calvert County, the impact depends on the duration of the event, severity of conditions, and area affected. The map above shows that Calvert County, and most of Maryland, is currently in moderate drought (USDM Scale: D1) conditions.

As stated above, climate change will have an effect on the frequency of droughts in the future. As global temperatures rise, weather patterns will change, increasing the number of dry days an area experiences. This could result in more drought periods for a local or regional area. Droughts could also become longer in duration, compared with pre-climate change patterns.

4.3.2.5 Vulnerability Assessment

The magnitude of drought vulnerability depends on the duration and area of impact. However, other factors contribute to the severity of a drought. Unseasonably high temperatures, prolonged winds, and low humidity can heighten the impact of a drought.

Extended periods of drought can lead to lowered stream levels, altering the delicate balance of riverine ecosystems. Certain tree species are susceptible to fungal infections during prolonged periods of soil moisture deficit. Fall droughts pose a particular threat because groundwater levels are typically at their lowest following height of the summer growing season. Calvert County's farmland can be negatively impacted by a drought event. With 280 farms located in Calvert County as reported in the 2017 Census of Agriculture, with a total market share of $6,322,000.00, a drought could cause significant economic strain on the county, the local Town Centers, and the residents. As stated above, a drought event could affect approximately 25,152 acres in Calvert County. Crop yields alone in Calvert County that could be negatively impacted by a potential drought event are worth $5,701,000.00 based on 2017 information. That accounts for roughly 89% of the county market share in agricultural products. The most common crops vulnerable to drought in Calvert County are soybeans, corn for grain, forage (hay/haylage), and wheat.

Land use and major development is a factor that has the potential to impact the vulnerability to drought in Calvert County. Land use, especially agricultural land use, can exacerbate dry conditions, and these agricultural areas can be damaged by drought. As stated above, there are 25,152 acres of farmland in Calvert County. If the number of agricultural acres increases, that increases the potential vulnerability for drought impacts. Conversely, if the agricultural acres decrease, the potential vulnerability of agriculture to drought decreases.

There are many hazards that can be considered cascading hazards related to drought events. Wildfire is the most severe cascading hazard effect associated with drought. Wildfires can devastate wooded and agricultural areas, threatening natural resources and farm production facilities. With drought events, water infiltration into the ground becomes more difficult. This lack of infiltration can result in flash flooding events in areas of steep slopes, canyons, and rolling hills. A loss of vegetation from a drought can also increase the occurrence of landslides in areas of steep slopes with loose packed soil profiles. A discussion on the county's vulnerability to wildfire, flash floods, and landslides can be found in Section 4.3.14.5, 4.3.5.5, and 4.3.9.5 respectively.

Additionally, emergency services can be adversely impacted by drought as a cascading hazard. Local fire departments often utilize ponds, creeks, and streams for water onboard fire apparatus. With low water levels in waterbodies, responders may be unable to draft enough water to efficiently respond to and extinguish a fire. Also, with an increased number of potential wildfires due to drought conditions, agencies may not have the personnel to efficiently respond to all fires in a timely manner.

A map of properties with tillable agricultural land use, forestry, and other land in the county vulnerable to drought is shown below in *Figure 11 – Drought-Vulnerable Land Cover*.

Municipalities with high risk due to droughts:

- Town of Chesapeake Beach
- Town of North Beach

Populations in Calvert County, including the socially vulnerable and unserved populations, are at different levels of vulnerability. The socially vulnerable have an increased risk due to the unsheltered or homeless not having access to reliable sources of water. Also, those individuals who are considered socially vulnerable because of location in rural areas are also at an increased risk because of agricultural and well status.

As seen in *Table 2 – Population Change in Calvert County*, the Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. Based on this information, it can be speculated that these municipalities may have an increased risk to droughts, since 2010, due to the increase in population.

Figure 10 - Current Drought Index for Maryland

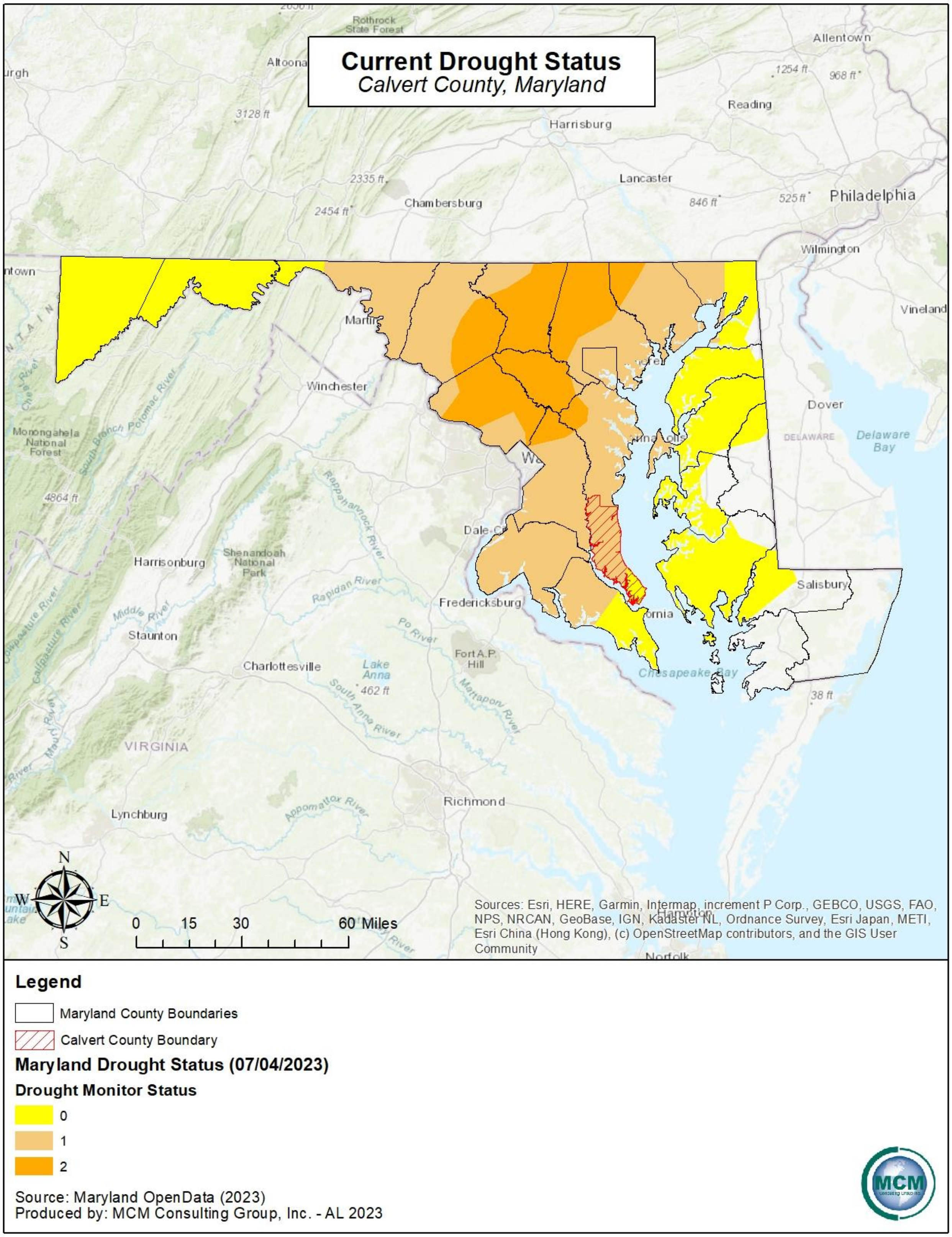


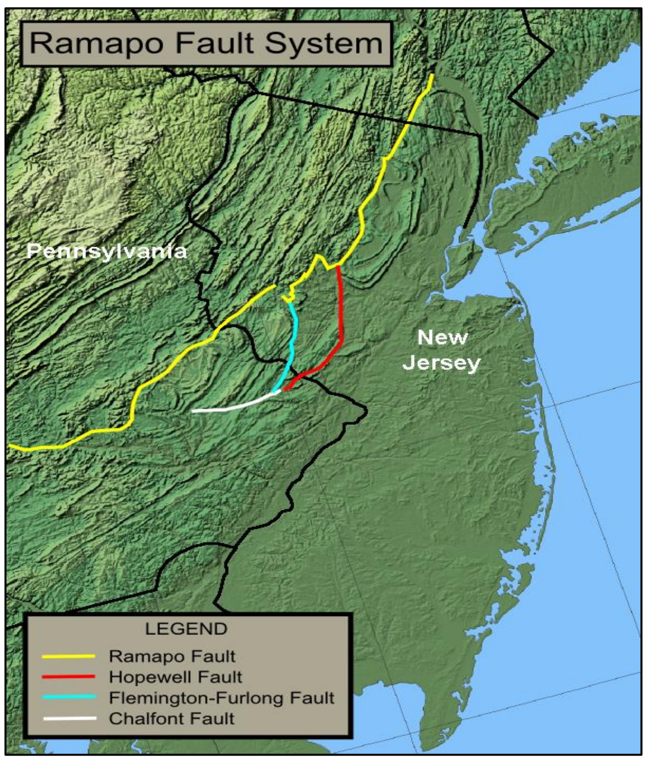
Figure 11 - Drought-Vulnerable Land Cover

4.3.3. Earthquake

4.3.3.1 Location and Extent

An earthquake is sudden movement of the earth's surface caused by the release of stress accumulated within or along the edge off the earth's tectonic plates, a volcanic eruption, or by a human induced explosion. Earthquake events in Maryland, including Calvert County, are usually mild events, impacting areas no greater than sixty miles in diameter from the epicenter. A majority of earthquakes occur along boundaries between tectonic plates, and some earthquakes occur at faults on the interior of plates. Today, Eastern North America, including Calvert County and Maryland, is far from the nearest plate boundary. That plate boundary is the Mid-Atlantic Ridge and is approximately 2,000 miles to the east, under the Atlantic Ocean. The Ramapo Fault System runs through New York, New Jersey, and eastern Pennsylvania (See *Figure 12 – Ramapo Fault System*). This fault system is associated with some small earthquakes in Maryland, and it is thought unlikely to produce significant disruption.

Figure 12 - Ramapo Fault System



Calvert County has also felt earthquake and seismic activity from the Central Virginia Seismic Zone. While this area is located in Virginia near the James and S. Anna rivers, it has caused significant events for Calvert County, Maryland.

When the supercontinent of Pangaea broke apart about 200 million years ago, the Atlantic Ocean began to form. Since then, many faults have developed. Locating all the faults would be an ideal approach to identifying the region's earthquake hazard; however, many of the fault lines in this region have no seismicity associated with them. The best way to determine earthquake history for Calvert County is to conduct a probabilistic earthquake-hazard analysis with the earthquakes that have already happened in and around the county. (See *Figure 13 – Maryland Earthquake Hazard Risk*). Nevertheless, the United States Geological Survey (USGS) indicates that Calvert County has a low earthquake risk, and only one historical event occurred within the county in 1874.

4.3.3.2 Range of Magnitude

Earthquakes result in the propagation of seismic waves, which are detected using seismographs. These seismograph results are measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake. *Table 15 – Richter Scale* summarizes Richter Scale magnitudes as they relate to the spatial extent of impacted areas. The Modified Mercalli Intensity Scale (*Table 16 – Modified Mercalli Intensity Scale*) is an alternative measure of earthquake intensity that is scaled by the impacts of the earthquake event. Earthquakes have many secondary impacts, including disrupting critical facilities, transportation routes, public water supplies and other utilities.

Table 15 - Richter Scale

Richter Scale	
Richter Magnitude	**Earthquake Effects**
Less than 3.5	Not generally felt but recorded.
3.5-5.4	Often felt, but rarely causes damage.
Under 6.0	At most, slight damage to well-designed buildings; can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive in areas where people live up to about 100 kilometers across.
7.0-7.9	Major earthquake; can cause serious damage over large areas.
8.0 or greater	Great earthquake; can cause serious damage in areas several hundred kilometers across.

Table 16 - Modified Mercalli Intensity Scale

Modified Mercalli Intensity Scale			
Scale	**Intensity**	**Earthquake Effects**	**Richter Scale Magnitude**
I	**Instrumental**	Detected only on seismographs.	<4.2
II	**Feeble**	Some people feel it.	
III	**Slight**	Felt by people resting, like a truck rumbling by.	
IV	**Moderate**	Felt by people walking.	
V	**Slightly Strong**	Sleepers awake; church bells ring.	<4.8
VI	**Strong**	Trees sway; suspended objects swing; objects fall off shelves.	<5.4
VII	**Very Strong**	Mild alarm, walls crack, plaster falls.	<6.1
VIII	**Destructive**	Moving cars uncontrollable, masonry fractures, poorly constructed buildings damaged.	<6.9
IX	**Ruinous**	Some houses collapse, ground cracks, pipes break open.	
X	**Disastrous**	Ground cracks profusely, many buildings destroyed, liquefaction and landslides widespread.	<7.3
XI	**Very Disastrous**	Most buildings and bridges collapse, roads, railways, pipes, and cables destroyed, general triggering of other hazards.	<8.1
XII	**Catastrophic**	Total destruction, trees fall, ground rises and falls in waves.	>8.1

4.3.3.3 Past Occurrence

According to Maryland Geological Survey, one earthquake had an epicenter within Calvert County since 1724. This earthquake event occurred on April 10th, 1874 and had a magnitude of approximately 2.7. However, several seismic events that occurred outside the county boundary may have been felt in the region.

Strong past events have occurred moderately close to Maryland and Calvert County. On August 23rd, 2011, a 5.9 earthquake occurred in Virginia, near the town of Mineral, VA. A 3.4

magnitude earthquake occurred on July 16th, 2010 near the Potomac-Shenandoah region of Maryland.

Because the effects of large earthquakes can be felt hundreds of miles away, the historical earthquake epicenters near Calvert County are shown below at *Figure 14 – Maryland Earthquake Activity.* A wider depiction of earthquake occurrences in the northeastern United States may be found here: https://earthquake.usgs.gov/earthquakes/map/?extent=14.26438,-141.32813&extent=56.51102,-48.60352

4.3.3.4 Future Occurrence

Earthquake activity and intensities are difficult to predict, but a probabilistic analysis of prior earthquakes can assist in gauging the likelihood of future occurrences. Calvert County is in a low hazard zone for earthquake activity according to the USGS, suggesting a low probability of earthquake occurrence. However, according to the USGS, there has been a recent trend increasing the frequency of magnitude three and larger earthquakes in the central and eastern U.S. (*Table 17 – Recent Earthquake Trends in Northeastern United States*).

Table 17 - Recent Earthquake Trends in Northeastern United States

Earthquake Trends in Northeastern U.S.	
Year	**Number of Magnitude 3+ Earthquakes**
2015	0
2016	3
2017	4
2018	0
2019	5
2020	3
Source: USGS, 2020	

Climate change and its relationship with earthquakes is hard to identify. According to the U.S Geological Survey, climate change and earthquakes correlation occurs when there is a large change in atmospheric pressure that can be caused by major storms which then could cause slow, small earthquakes. With the release of energy from small earthquakes, over time that energy can lead to ground shaking earthquakes that can cause damage more severe damage. This theory is not yet proven and is still subject to change, but can provide some context to climate change's impact.

4.3.3.5 Vulnerability Assessment

According to the U.S. Geological Society Earthquake Hazards Program, an earthquake hazard is anything associated with an earthquake that may affect a resident's normal activities. For Calvert County, this could include surface faulting, ground shaking, landslides, liquefaction, dried or rejuvenated water wells, tectonic deformation, and seiches (sloshing of a closed body of water from earthquake shaking).

Earthquakes usually occur without warning and can impact areas a great distance from their point of origin (epicenter). Ground shaking is the greatest risk to building damage within Calvert County. Risk to public safety and loss of life from an earthquake is dependent upon the severity and proximity of the event. Injury or death to those inside buildings, or people walking below building ornamentation and chimneys is a higher risk to Calvert County's general public during an earthquake. Infrastructure is more at risk on the east coast than the west coast because its buildings are older.

Impact of earthquakes on historic properties in Calvert County

All of the historic properties that are located in Calvert County are at an increased vulnerability to earthquakes. The vulnerability of each is related to the construction practices of the property at the time that it was constructed. Many of the historic properties in Calvert County were constructed before 1900 and are of a type of construction vulnerable to increased seismic events (brick and stone).

Municipalities with high risk due to earthquakes:

- Town of Chesapeake Beach
- Town of North Beach

All of the socially vulnerable populations in Calvert County are at an increased vulnerability to earthquakes. The homeless and the unsheltered populations are at risk if they are living in structurally unsound buildings and locations. Also, the economically vulnerable of Calvert County may not have the capability to fix or rebuild if their homes are damaged from an earthquake event.

As seen in *Table 2 – Population Change in Calvert County*, the Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. Based on this information, it can be speculated that these municipalities may have an increased/equivalent risk to earthquakes, since 2010, due to the increase in population and construction.

Land use is a factor that has the potential to impact an earthquake severity. Land use, in the form of a built environment, such as residential expansion, can cause earthquakes impact severity to increase. Impact severity increases because as the built environment expands and becomes more complex, the impact the event will have on that area also increases because there is an influx of people, infrastructure, and critical infrastructure in the hazard area.

The seismic forces associated with an earthquake pose an immediate threat to telecommunication infrastructure, or other critical infrastructure in a community. When an earthquake occurs, the resulting ground instability can lead to telephone pole collapse, disruption of fiber or copper cables systems, and in severe cases, cellular tower failure. The disruption to these networks, if the earthquake event is significant, can also result in a loss of communication capabilities, hindering response coordination, and leaving communities impacted by the earthquake vulnerable to other natural or human-caused hazards.

Earthquakes can also damage power distribution systems, leading to localized power outages or even widespread blackouts. Fallen power lines, damaged substations, and disrupted transformers may further contribute to the breakdown of the electrical grid surrounding the epicenter of the earthquake, and the consequences can include cascading pressure on essential services and other community lifelines, further impeding emergency operations and the capabilities within the impacted jurisdictions.

Earthquake events can also pose a threat to natural gas, water, and the numerous other materials and chemicals transported through underground water systems in Calvert County. During significant earthquakes, underground pipelines may crack, causing the transported material to leak into the ground and contaminating water sources in the county. In severe cases, water line bursts can cause cascading hazard to subsidence and sinkholes, when left unchecked. However, even in more contained scenarios, a small leak can have profound impact if the transported material is toxic or hazardous in nature, leading to degradation of the natural resources in the impacted communities.

Figure 13 - Maryland Earthquake Hazard Risk

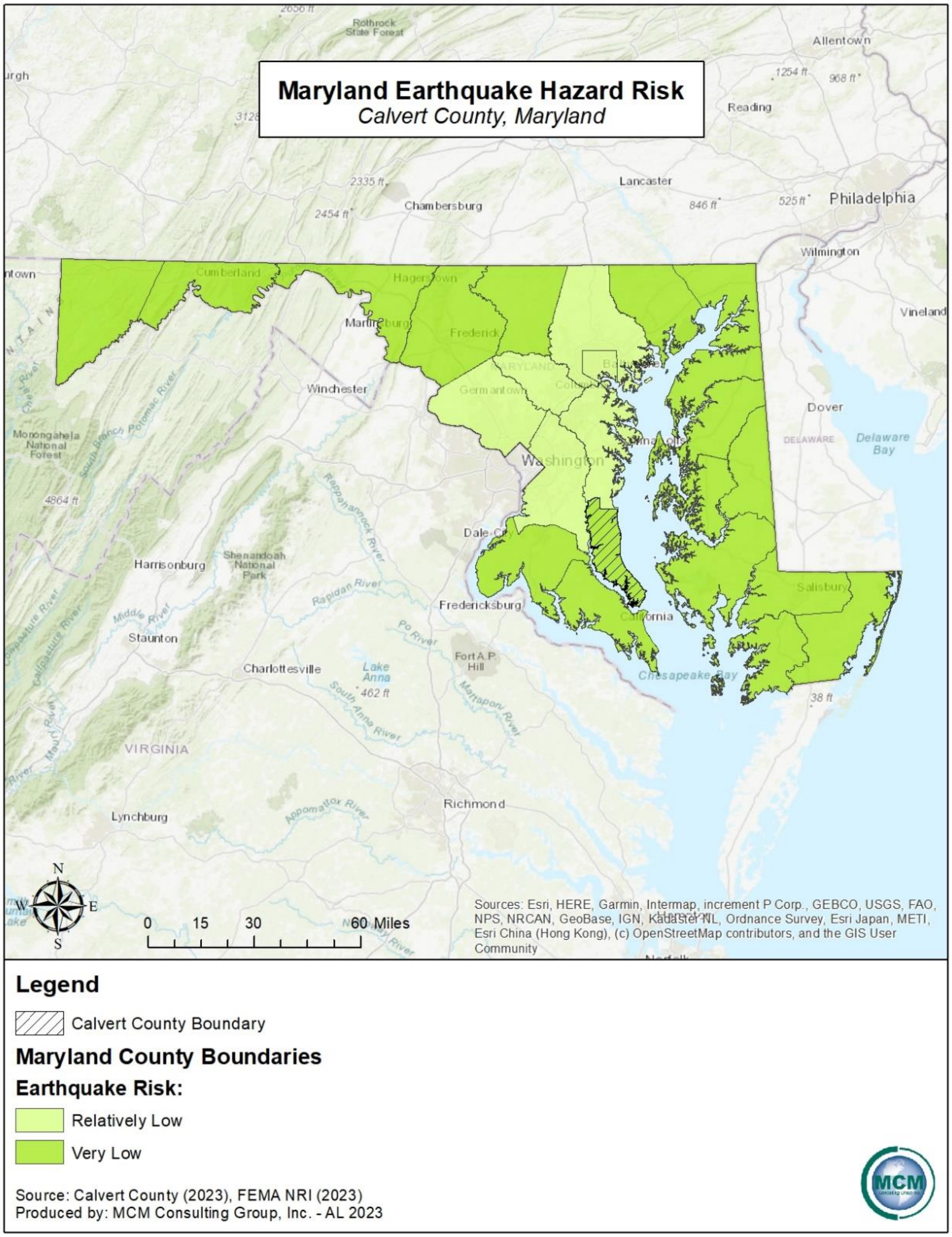
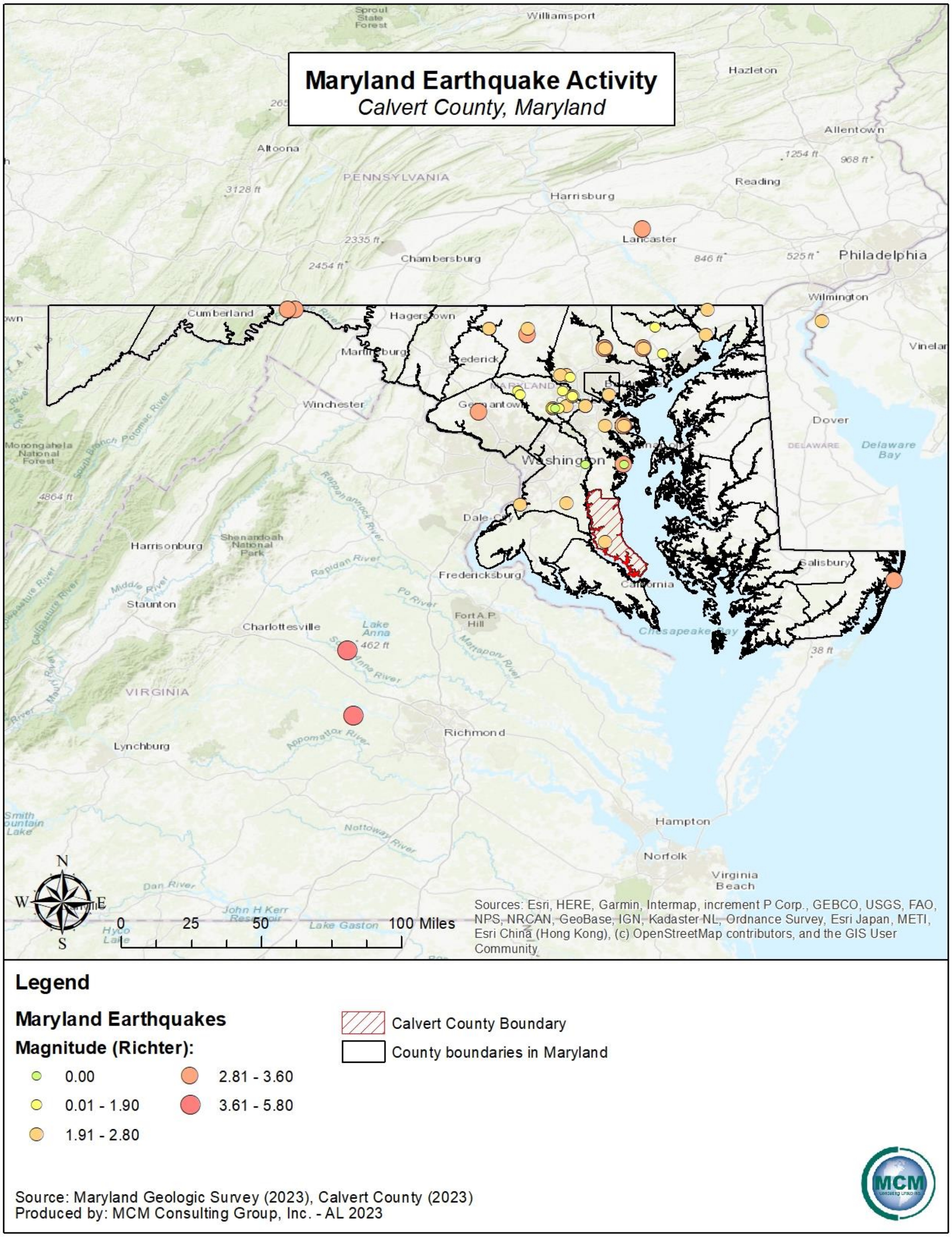


Figure 14 - Maryland Earthquake Activity



4.3.4. Extreme Temperatures

4.3.4.1 Location and Extent

Maryland, and more specifically, Calvert County can experience many different temperature extremes. High temperatures occur about ten days per year at any location in Maryland, however, southern parts of the state experience more. Freezing temperatures occur on an average of 100 or more days per year with longest freeze-free period at near sea level locations such as northwest Maryland (adjacent to Lake Erie). Extreme temperatures can be devastating – extreme heat can cause sunburn, heat cramps, heat exhaustion, heat stroke, and dehydration, while extreme cold can cause hypothermia and frostbite. Both can potentially cause long-lasting disabilities. January is typically the coldest month for Calvert County, with average temperatures of 37.3°F.

4.3.4.2 Range of Magnitude

When extreme temperature events occur, they typically impact the entirety of Calvert County, including the surrounding region. Extreme heat is described as temperatures that hover at least 10ºF above the average high temperature for a region during the summer months. Extreme heat is responsible for more deaths in Maryland than all other natural disasters combined. Temperature advisories, watches, and warnings are issued by the National Weather Service relating impacts to the range of temperatures typically experienced in Maryland. Heat advisories are issued when the heat index temperature is expected to be equal to 100°F, but less than 105°F. Excessive heat warnings are issued when heat indices will attain or exceed 105°F and are issued within twelve hours of the onset. Excessive heat watches are issued when there is a possibility that excessive heat warning criteria may be experienced within twenty-four to seventy-two hours, but their occurrence and timing are still uncertain. A potential worst-case extreme temperature scenario would be widespread areas of the state experiencing 90°F or higher temperatures for an extended number of days. The heat could overwhelm the power grid and cause widespread blackouts, cutting off vital HVAC services for residents. It could create crisis management issues for senior citizens on fixed incomes, the homeless, and other vulnerable populations. The heat index is a measurement that takes into account both the temperature and relative humidity, and it is calculated as shown in *Figure 15 - National Weather Service's Heat Index Matrix*.

Figure 15 - National Weather Service's Heat Index Matrix

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Extreme cold temperatures drop well below typical temperatures and are often associated with winter storm events. Wind can make the apparent temperature drop further, and exposure to such extreme cold temperatures can cause hypothermia, frost bite and death. Wind chill warnings are issued when wind chills drop to -25°F or lower. While this threshold applies to the entire state, the threshold for advisories varies based on regions. Wind chill advisories are issued in the south and western sections of Maryland, when wind chill values drop to -10°F to -24°F. Wind chill advisories are issued in the northern sections of the state when wind chills drop to -15°F to -24°F. The National Weather Service created a wind chill chart which shows the time frostbite takes to set in depending on temperature and wind speed as shown in *Figure 16 - National Weather Service's Wind Chill Matrix*.

Figure 16 - National Weather Service's Wind Chill Matrix

Wind Chill Chart

Temperature (°F)

Wind (mph) / Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

Wind Chill (°F) = $35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Source: NOAA NWS, 2001

4.3.4.3 Past Occurrence

Calvert County has had more past occurrences of extreme heat than extreme cold. *Table 18 - Past Extreme Temperature Occurrences for Calvert County* shows the past occurrence events associated with extreme temperature (hot and cold) that have occurred in Calvert County. The data in the table was reported from early 2000s to the year 2023. Due to the source used, no further events have been documented since 2020, however, events most likely have occurred without being documented. With a total of eleven different extreme temperature events that have occurred, five of the events were extreme cold related while the remaining six were extreme heat related. There were no reports of death or injury related to the occurrences. However, numerous sources have provided information regarding past occurrences and losses associated with extreme temperature in Calvert County and the state as a whole. Due to the number of sources available with information, number of events and losses could vary slightly in number.

Data from the National Climatic Data Center reports that there have been 303 extreme temperature episodes in Maryland from 2000 to present, resulting in a total of twenty deaths and two injuries. Out of the 303 events, 108 of them were extreme cold related with one death. The other 195 events were extreme heat related with nineteen deaths and two injuries across the state. The biggest event was on July 3, 2018, which had a significant effect on the Southern Baltimore Zone itself. In the 2018 event, there was a total of eight deaths and zero injuries within one day. Record-breaking heat temperatures were experienced in seventeen different zones.

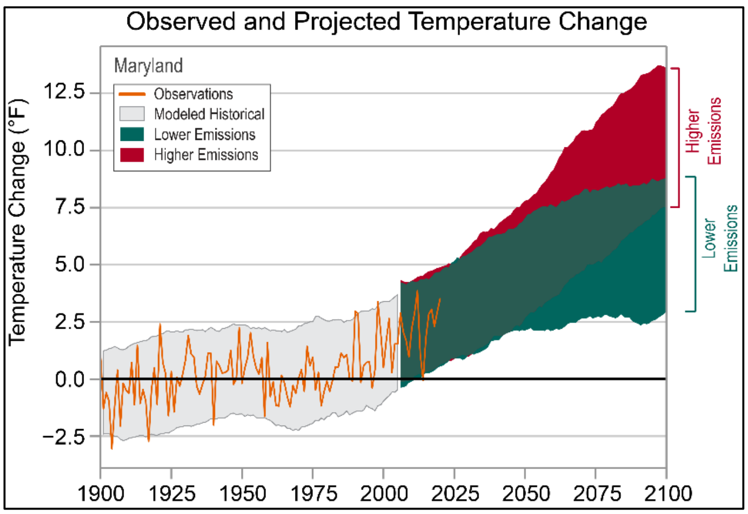
Table 18 - Past Extreme Temperature Occurrences for Calvert County

Past Extreme Temperature Occurrences for Calvert County		
Location	**Date**	**Type**
Calvert (Zone)	01/02/2000	Excessive Heat
Calvert (Zone)	01/21/2000	Extreme Cold/Wind Chill
Calvert (Zone)	01/22/2000	Extreme Cold/Wind Chill
Calvert (Zone)	01/27/2000	Extreme Cold/Wind Chill
Calvert (Zone)	12/22/2000	Extreme Cold/Wind Chill
Calvert (Zone)	04/19/2001	Extreme Cold/Wind Chill
Calvert (Zone)	07/22/2011	Excessive Heat
Calvert (Zone)	07/03/2018	Excessive Heat
Calvert (Zone)	07/20/2019	Excessive Heat
Calvert (Zone)	07/21/2019	Excessive Heat
Calvert (Zone)	07/20/2020	Excessive Heat
Source: NOAA, 2023		

4.3.4.4 Future Occurrence

Extreme temperatures will continue to impact Calvert County in the future. Anthropogenic climate change is causing extreme climatic events to occur more frequently, suggesting that extreme temperatures are becoming a more threatening hazard as the impacts of climate change intensify. The annual average temperature has increased by 1.2˚F across the continental United States during the years 1986 to present compared to the time period 1901 to 1960 and temperatures are expected to continue rising. *Figure 17 – Observed and Projected Temperature Change for Maryland* shows these projected changes in temperature for Maryland based on climate models considering the possibilities of increased and decreased levels of greenhouse gas emissions. In recent years, record high temperatures have outnumbered record low temperatures 2:1 so it is expected that the risk of extreme heat will be amplified whereas the risk of extreme cold will be attenuated. The Northeastern United States is expected to experience twenty to thirty more days with temperatures above 90˚F, and twenty to thirty fewer days below freezing by approximately 2050. While there may be fewer extreme cold events, those that do occur are expected to reach record-setting low temperatures more often. Historically, Calvert County has had more extreme heat events than extreme cold events; however, this balance could shift somewhat in the coming years to include a greater proportion of extreme cold events.

Figure 17 - Observed and Projected Temperature Change for Maryland



Source: Frankson et al., 2017

Climate change can intensify extreme temperatures, leading to more frequent and severe heatwaves and cold spells. Rising global temperatures are linked to an increased frequency and intensity of heatwaves, impacting ecosystems, agriculture, and human health. Changes in the atmospheric circulation patterns can contribute to prolonged cold spells in certain regions. These extremes temperatures can disrupt ecosystems, endanger biodiversity, and pose threats to food security.

4.3.4.5 Vulnerability Assessment

Extreme temperatures are usually a regional hazard when they occur. The very old (sixty-five years or older, accounting for 16.5% of Calvert County population) and the very young (five years or younger, accounting for 5.2% of Calvert County population) are most vulnerable to extreme temperatures due to risk factors, mobility challenges, and disabilities. Extreme temperatures can increase the demand for utility services, often resulting in an increased cost which some consumers may be unable to afford. The increased demand for services may cause a decrease in availability of these services or failure of the system. A decrease or failure of the utility system during extreme temperature events would put a large population at great risk. Extreme temperature events can also drastically increase the volume of emergency calls, potentially overwhelming the public safety communications center. Extreme heat events can also contribute to drought conditions, which in turn increase the risk of wildfire, as discussed in Section 4.3.2 and 4.3.14.

As discussed above, climate change will worsen extreme temperature events including both extreme cold and extreme heat events. With temperatures migrating further from past observations, and closer to extreme zones, planning must be undertaken to address those issues. With the increase in future extreme temperature events, the vulnerable populations of Calvert County will continue to be at increased risk to those events. The resources required to respond to those events will increase as warming and cooling shelters are needed more frequently.

Municipalities with high risk to extreme temperatures:

- Town of Chesapeake Beach
- Town of North Beach

Extreme temperatures can have a significant impact on land use within Calvert County. Higher temperatures can affect mountain snowpacks and vegetation land. It is important to note that higher land use and irrigation can cause more intense extreme temperatures. Based on this information it can be speculated that higher land use within the municipalities in Calvert County will be impacted.

As seen in *Table 2 – Population Change in Calvert County*, the Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. Based on this information, it can be speculated that these municipalities may have an increased vulnerability to extreme temperatures, since 2010, due to the increase in population. Populations in Calvert County, including the socially vulnerable and unserved populations, are at different levels of vulnerability. The socially vulnerable have an increased vulnerability and risk due to the unsheltered or homeless not having proper and adequate access to shelter and heating, ventilation, and air conditioning (HVAC) to protect them from extreme temperature events.

Extreme temperatures can have a significant impact on natural areas. Consecutive days of excessive heat or extreme cold can lead to the diminishment of natural habitats within Calvert County. Excessive heat and extreme cold can cause natural areas to lose the nourishment that is needed for them to survive and destroy the equilibrium within them. If trends continue there will be more days of excessive heat in the coming years that could impact the equilibrium in these natural areas and change their geographic features. Extreme temperatures and lack of rainfall can lead to drought and the diminishment of rivers and vegetation within the area.

4.3.5. Flooding, Flash Flooding, and Nuisance Flooding

4.3.5.1 Location and Extent

Flooding is the temporary condition of partial or complete inundation on normally dry land and it is the most frequent and costly of all hazards in Maryland. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period. Flash flooding is usually the result of heavy, localized precipitation falling in a short period of time over a given location, often in mountain streams and mountainous regions, and in urban areas where much of the ground is covered in impervious surfaces. Flash floods are relatively common in Calvert County and the severity of those flood events is dependent upon a combination of creek, stream, and river basin topography and physiography, hydrology, precipitation, and weather patterns. Present soil conditions, the degree of vegetative clearing, and the presence of impervious cover must also be considered when determining the severity of a flood or flood event. Precipitation information for the above comes from NOAA and the National Weather Service for Calvert County.

Winter flooding can include ice jams, which occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rains can cause frozen rivers to swell, which breaks the ice layer on top of a river. The ice layer often breaks into large chunks, which float downstream, piling up in narrow passages and near other obstructions such as bridges and dams. All forms of flooding can damage infrastructure.

Floodplains are lowlands adjacent to rivers, streams, and creeks that are subject to recurring floods. The size of the floodplain is described by the recurrence interval of a given flood event. Flood recurrence intervals are explained in more detail in section 4.3.5.4. However, in assessing the potential spatial extent of flooding, it is important to know that a floodplain associated with a flood that has a 10% chance of occurring in a given year is smaller than a floodplain associated with a flood that has a 0.2% chance of occurring.

The National Flood Insurance Program (NFIP) publishes digital flood insurance rate maps (DFIRMs). These maps identify the 1% annual chance of flood area. The special flood hazard area (SFHA) and base flood elevations (BFE) are developed from the 1% annual chance flood event as seen in *Figure 18 – Flooding and Floodplain Diagram*. Structure located within the SFHA have a 26% chance of flooding in a thirty-year period. The SFHA serves as the primary regulatory boundary used by FEMA, the State of Maryland, and the Calvert County local government. Federal floodplain management regulations and mandatory flood insurance purchase requirements apply to the following high-risk special flood hazard areas in *Table 19 – Flood Hazard High Risk Zones*. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Calvert County with vulnerable structures and community lifeline facilities identified using the most current DFIRM data for Calvert County.

Past flooding events have been primarily caused by heavy rains, which cause small creeks and streams to overflow their banks, often leading to road closures. Flooding poses a threat to community lifeline facilities, agricultural areas, and those who reside or conduct business in the floodplain. The most significant hazard exists for facilities in the floodplain that process, use, or store hazardous materials. A flood could potentially release and transport hazardous materials throughout the area. Most flood damage to a property and structure located in the floodplain is caused by water exposure to the interior, high velocity water, and debris flow.

Figure 18 - Flooding and Floodplain Diagram

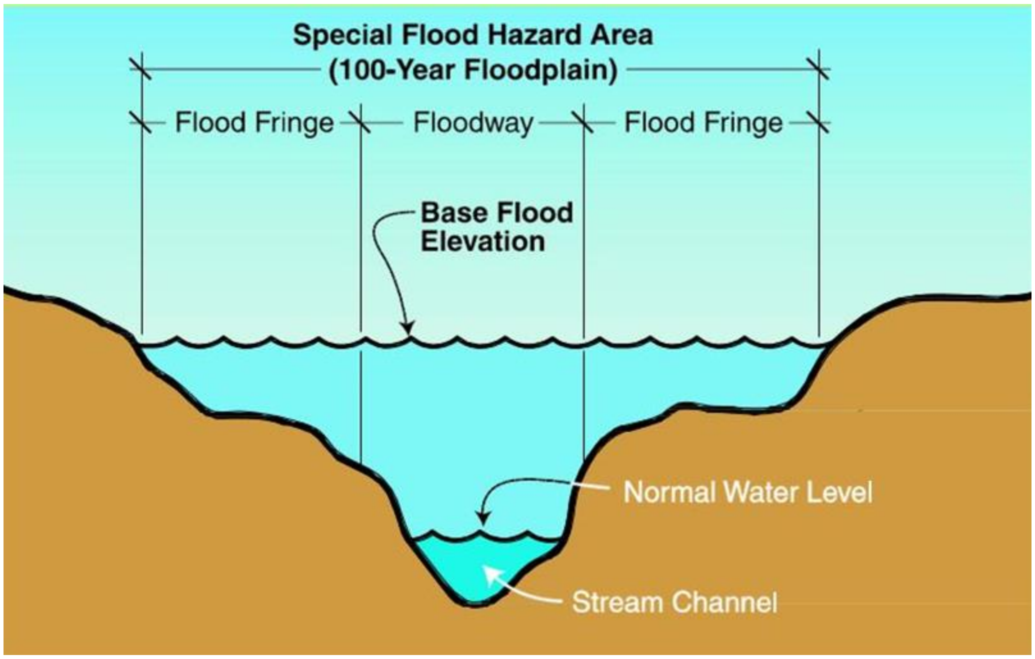


Table 19 - Flood Hazard High Risk Zones

Flood Hazard High Risk Zones	
Zone	**Description**
A	Areas subject to inundation by the 1% annual chance flood event. Because detailed hydraulic analysis has not been performed, no base flood elevations or flood depths are shown.
AE	Areas subject to inundation by the 1% annual chance flood event determined by detailed methods. BFEs are shown within these zones.
AH	Areas subject to inundation by the 1% annual chance shallow flooding (usually areas of ponding) where average depths are 1 – 3 feet. BFEs derived from detailed hydraulic analysis are shown in this zone.
AO	Areas subject to inundation by the 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are 1 – 3 feet. Average flood depths derived from detailed hydraulic analysis are shown within this zone.
AR	Areas that result from the decertification of a previously accredited flood protection system that is determined to be in the process of being restored to provide base flood protection.
Source: FEMA, 2017	

4.3.5.2 Range of Magnitude

The Chesapeake Bay has caused significant flooding in Calvert County, specifically on the following streams, creeks, and their tributaries:

- Patuxent River
    - Hall Creek
    - Little Lyons Creek
    - Mill Creek
    - Back Creek
    - St. John Creek

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover, and the rate of snowmelt. Water runoff is greater in areas with steep slopes and little to no vegetative ground cover. The terrain of Calvert County can cause more severe floods as runoff reaches receiving water bodies more rapidly over steep terrain. This is of particular concern for areas along steep slopes and on the edges of gullies throughout Calvert County.

Urbanization typically results in the replacement of vegetative ground cover with impermeable surfaces like asphalt and concrete, increasing the volume of surface runoff and stormwater, particularly in areas with poorly planned stormwater drainage systems. A large amount of rainfall over a short time span can cause flash flood events. Flash floods can occur very quickly and with little warning. A flash flood can also be deadly because of the rapid rise in water levels and devastating flow velocities. The more developed areas in the county can be easily susceptible to flash floods because of the significant presence of impervious surfaces, such as streets, sidewalks, parking lots, and driveways. Additionally, small amounts of rain can cause floods in locations where the soil is still frozen, saturated from a previous wet period or if the areas is largely covered in impermeable surfaces such as parking lots, paved roadways, and other developed areas. The county occasionally experiences intense rainfall from tropical storms in later summer and early fall, which can potentially cause flooding as well.

Severe flooding can cause injuries and deaths and can have long-term impacts on the health and safety of citizens. Severe flooding can also result in significant property damage, potentially disrupting the regular function of community lifeline facilities and can have widespread negative effects on local economies. Industrial, commercial, and public infrastructure facilities can become inundated with flood waters, threatening the continuity of government and business. The vulnerable populations must be identified and located in flooding situations, as they are often home bound. Mobile homes and manufactured structures are especially vulnerable to high water levels. Flooding can have significant environmental impacts when the flood water release and/or transport hazardous materials.

Severe flooding also comes with secondary effects that could have long lasting impacts on the population, economy, and infrastructure within Calvert County. Power failures are the most common secondary effect associated with flooding. Coupled with a shortage of critical services and supplies, power failures could cause a public health emergency. Community lifelines, such as sewage and water treatment facilities, can fail, causing sewage overflows and the contamination of groundwater and drinking water. Flooding also has the potential to trigger other hazards, such as landslides, hazardous material spills, and dam failures.

The maximum threat of flooding for Calvert County is estimated by looking at the potential loss data and repetitive loss data, both analyzed in the risk assessment section of the hazard mitigation plan. In these cases, the severity and frequency of damage can result in permanent population displacement, and business may close if they are unable to recover from the disaster.

Estimation of potential loss is completed through FEMA's HAZUS software. A level two HAZUS scenario was performed for the entirety of Calvert County. The FEMA Global Flood Risk Report and other reports generated by the software at the end of the scenario were utilized to estimate the amount of damage and loss from a flood. The total building loss for a 100-year flood based on a HAZUS level two scenario is displayed in *Table 20 – HAZUS Building Economic Loss Figures*. The total business interruption vales occurring from a proposed 100-year flood based on FEMA HAZUS data is illustrated in *Table 21 – HAZUS Business Interruption Economic Loss Figures*. *Figure 19 – Loss by Occupancy Type* illustrates the breakdown of economic losses by either residential, commercial, industrial, or other use type.

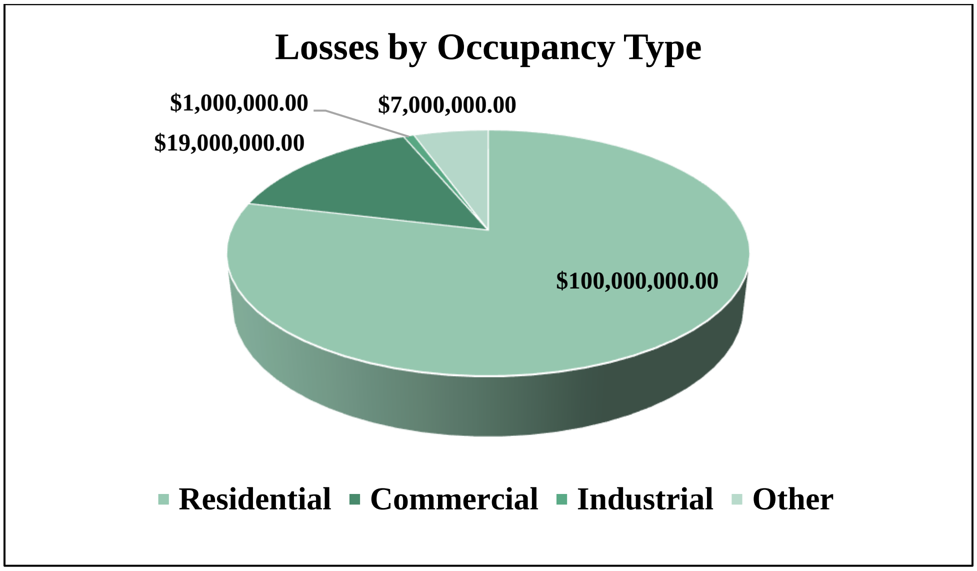
Table 20 - HAZUS Building Economic Loss Figures

HAZUS Building Economic Loss Figures					
	Residential	**Commercial**	**Industrial**	**Other**	**Total**
Building:	$48,660,000.00	$960,000.00	$330,000.00	$140,000.00	$50,090,000.00
Content:	$29,830,000.00	$2,970,000.00	$520,000.00	$1,120,000.00	$34,440,000.00
Inventory:	$0.00	$40,000.00	$50,000.00	$0.00	$90,000.00
Subtotal:	$78,490,000.00	$3,970,000.00	$900,000.00	$1,260,000.00	$84,620,000.00
Source: HAZUS, 2023					

Table 21 - HAZUS Business Interruption Economic Loss Figures

HAZUS Business Interruption Economic Loss Figures					
	Residential	**Commercial**	**Industrial**	**Other**	**Total**
Income:	$210,000.00	$6,990,000.00	$30,000.00	$1,180,000.00	$8,410,000.00
Relocation:	$16,090,000.00	$1,000,000.00	$20,000.00	$310,000.00	$17,420,000.00
Rental Income:	$5,010,000.00	$770,000.00	$0.00	$30,000.00	$5,810,000.00
Wage:	$500,000.00	$6,070,000.00	$60,000.00	$3,880,000.00	$10,510,000.00
Subtotal:	$21,810,000.00	$14,830,000.00	$110,000.00	$5,400,000.00	$42,150,000.00
Source: HAZUS, 2023					

Figure 19 - Loss by Occupancy Type



Although floods can cause deaths, injuries, and damage to property, they are naturally occurring events that benefit riparian systems which have not been disrupted by human actions. Such benefits include groundwater recharge and the introduction of nutrient rich sediments which improves soil fertility. However, human development often disrupts natural riparian buffers by changing land use and land cover, and the introduction of chemical or biological contaminants that often accompany human presence can contaminate habitats after flood events.

4.3.5.3 Past Occurrence

Calvert County has experienced numerous flooding and flash flooding events in the past. The flooding and flash flooding were caused by a variety of heavy storms, inclement weather, tropical storms, and other issues. A summary of recent flood event history for Calvert County from January 1996 to May 2022 is found in *Table 22 – Past Flood and Flash Flood Events*. Details of each event can be found in NOAA's National Center for Environmental Information (NCEI) database. Additional data was also acquired by examining Calvert County's 2017 HMP.

Table 22 - Past Flood and Flash Flood Events

Past Flood and Flash Flood Events			
Event Location	**Event Date**	**Event Type**	**Property Damage Estimate**
Prince Frederick	06/20/1996	Flash Flood	$-
Along Chesapeake Bay	09/06/1996	Storm Surge Flood	$750,000.00
Coastal Zone	10/08/1996	Flood	$10,000.00
Countywide	01/28/1998	Flash Flood	$5,000.00
Countywide	02/04-05/1998	Flash Flood	$230,000.00
Countywide	09/16/1999	Flash Flood	$500,000.00

Past Flood and Flash Flood Events			
Event Location	**Event Date**	**Event Type**	**Property Damage Estimate**
Countywide	07/26/2000	Flash Flood	$-
North Portion	09/02/2000	Flash Flood	$-
Dunkirk	06/25/2004	Flash Flood	$-
Calvert (zone)	01/14/2005	Flood	$-
Chesapeake Beach	06/26/2006	Flash Flood	$-
Long Beach	05/12/2008	Flood	$-
North Beach	08/22/2009	Flash Flood	$-
Owings	08/22/2009	Flash Flood	$-
North Beach	09/30/2010	Flash Flood	$-
Appeal	09/30/2010	Flash Flood	$-
Stoakley	09/30/2010	Flash Flood	$-
Randle Cliff Beach	09/08/2011	Flash Flood	$-
North Beach	09/08/2011	Flash Flood	$-
Lower Marlboro	09/09/2011	Flood	$-
Owings	09/09/2011	Flood	$-
Appeal	08/26/2012	Flash Flood	$-
North Beach	06/18/2013	Flash Flood	$-
Lower Marlboro	06/18/2013	Flash Flood	$-
Solomons	06/30/2013	Flash Flood	$-
Randle Cliff Beach	05/02/2016	Flood	$-
North Beach	05/02/2016	Flood	$-
North Beach	05/29/2016	Flash Flood	$-
North Beach	07/01/2016	Flood	$5,000.00
Appeal	07/06/2017	Flash Flood	$-
Bowens	05/27/2018	Flood	$-
Prince Frederick	05/27/2018	Flood	$-
Sunderland	07/22/2018	Flood	$-
Chaneyville	07/22/2018	Flood	$-
Randle Cliff Beach	07/22/2018	Flood	$-
Bowens	07/22/2018	Flood	$-
Huntingtown	07/22/2018	Flood	$-
Dunkirk	07/22/2018	Flood	$-
Barstow	08/11/2018	Flood	$-
Prince Frederick	10/11/2018	Flood	$-
Chaneyville	10/11/2018	Flood	$-
Randle Cliff Beach	07/31/2019	Flood	$-
Chaneyville	08/04/2020	Flood	$-
Port Republic	08/04/2020	Flood	$-

Past Flood and Flash Flood Events			
Event Location	**Event Date**	**Event Type**	**Property Damage Estimate**
Prince Frederick	08/04/2020	Flood	$-
Stoakley	08/04/2020	Flood	$-
Chesapeake Ranch Est	07/09/2021	Flood	$-
Dares Beach	08/14/2021	Flash Flood	$-
Dares Beach	08/20/2021	Flood	$-
Mt Harmony	05/22/2022	Flood	$-
		Total:	**$1,500,000.00**
Source: NCEI NOAA, 2023 *Property Damage Values are estimated and are not exact figures. Data from NCEI and Calvert County 2017 HMP **Any items labeled $- is listed as $0.00 by the NCEI but is not guaranteed to have no damage			

The National Flood Insurance Program (NFIP) identifies properties that frequently experience flooding. Repetitive loss properties are structures insured under the NFIP which have had at least two paid flood losses of more than $1,000 over any ten-year period since 1978. The hazard mitigation assistance (HMA) definition of a repetitive loss property is a structure covered by a contract for flood insurance made available under the NFIP that has incurred flood-related damage on two occasions, in which the cost of repair, on average, equaled or exceeded 25% of the market value of the structure at the time of each such flood event; and at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage. *Table 23 – Repetitive Loss Properties* illustrates the communities that have repetitive loss properties, the total building payments, the contents payments, and the number of losses and properties. There are fifty-five repetitive loss properties in Calvert County. *Table 24 – Summary of Type of Repetitive Loss Properties by Municipality* illustrates the breakdown of type of repetitive loss properties in Calvert County.

A property is considered a severe repetitive loss property either when there are at least four losses each exceeding $5,000 or when there are two or more losses where the building payments exceed the property value. *Table 25 – Severe Repetitive Loss Properties* illustrates the communities within Calvert County that have severe repetitive loss properties, the total building payments, the contents payments, and the number of losses and properties. The data used in the table is based on data provided by FEMA and MDEM.

All municipalities in Calvert County participate in the NFIP.

Table 23 - Repetitive Loss Properties

Repetitive Loss Properties						
Community Name	**Community Number**	**Cumulative Building Payment**	**Cumulative Contents Payment**	**Sum of Total Paid**	**Losses**	**Properties**
Calvert County	240011	$15,943.10	$0.00	$15,943.10	3	1
Calvert County	240011	$175,000.00	$2,105.00	$177,105.00	2	1
Calvert County	240011	$35,834.63	$5,508.10	$41,342.73	3	1
Calvert County	240011	$66,323.42	$12,252.83	$78,576.25	5	1
Calvert County	240011	$44,014.89	$0.00	$44,014.89	3	1
Calvert County	240011	$18,009.50	$1,432.10	$19,441.60	2	1
Calvert County	240011	$29,269.40	$0.00	$29,269.40	2	1
Calvert County	240011	$26,571.26	$0.00	$26,571.26	2	1
Calvert County	240011	$53,231.30	$6,607.17	$59,838.47	2	1
Calvert County	240011	$49,277.76	$12,081.29	$61,359.05	2	1
Calvert County	240011	$38,861.67	$6,905.99	$45,767.66	2	1
Calvert County	240011	$31,694.67	$0.00	$31,694.67	2	1
Calvert County	240011	$44,171.53	$0.00	$44,171.53	2	1
Calvert County	240011	$22,731.92	$0.00	$22,731.92	2	1
Calvert County	240011	$44,453.66	$16,310.00	$60,763.66	2	1
Calvert County	240011	$56,766.23	$0.00	$56,766.23	2	1
Calvert County	240011	$45,887.14	$0.00	$45,887.14	2	1
Calvert County	240011	$28,477.71	$0.00	$28,477.71	3	1
Calvert County	240011	$105,176.89	$0.00	$105,176.89	3	1
Calvert County	240011	$39,519.84	$33,954.59	$73,474.43	2	1
Calvert County	240011	$86,942.71	$0.00	$86,942.71	2	1
Calvert County	240011	$74,981.55	$12,559.69	$87,541.24	3	1
Calvert County	240011	$14,130.65	$0.00	$14,130.65	2	1
Calvert County	240011	$35,727.55	$5,000.00	$40,727.55	2	1
Calvert County	240011	$57,164.43	$43,393.34	$100,557.77	3	1
Calvert County	240011	$42,404.37	$1,717.76	$44,122.13	2	1
Calvert County	240011	$3,127.91	$0.00	$3,127.91	2	1
Calvert County	240011	$17,079.83	$0.00	$17,079.83	3	1
Calvert County	240011	$12,685.65	$0.00	$12,685.65	2	1
Calvert County	240011	$8,304.96	$333.47	$8,638.43	3	1
Calvert County	240011	$11,802.85	$0.00	$11,802.85	2	1
Calvert County	240011	$42,525.01	$5,486.21	$48,011.22	2	1
Calvert County	240011	$16,762.99	$0.00	$16,762.99	2	1
Calvert County	240011	$19,954.31	$0.00	$19,954.31	3	1
Calvert County	240011	$23,924.63	$0.00	$23,924.63	2	1

Repetitive Loss Properties						
Community Name	**Community Number**	**Cumulative Building Payment**	**Cumulative Contents Payment**	**Sum of Total Paid**	**Losses**	**Properties**
Calvert County	240011	$24,282.81	$990.07	$25,272.88	2	1
Calvert County	240011	$48,332.03	$0.00	$48,332.03	4	1
Calvert County	240011	$35,837.33	$10,805.53	$46,642.86	3	1
Calvert County	240011	$35,000	$0.00	$35,000.00	2	1
Chesapeake Beach	240100	$173,989.45	$60,000.00	$233,989.45	2	1
Chesapeake Beach	240100	$19,166.24	$915.00	$20,081.24	2	1
North Beach	240012	$49,750.82	$8,943.57	$58,694.39	4	1
North Beach	240012	$29,128.92	$0.00	$29,128.92	3	1
North Beach	240012	$154,380.48	$1,219.23	$155,599.71	5	1
North Beach	240012	$17,336.75	$0.00	$17,336.75	2	1
North Beach	240012	$27,361.14	$0.00	$27,361.14	3	1
North Beach	240012	$40,024.13	$0.00	$40,024.13	2	1
North Beach	240012	$56,726.40	$0.00	$56,726.40	2	1
North Beach	240012	$103,270.43	$5,750.06	$109,020.49	2	1
North Beach	240012	$2,2807.16	$0.00	$22,807.16	3	1
North Beach	240012	$62,114.63	$23,345.85	$85,460.48	2	1
North Beach	240012	$64,139.07	$7,640.38	$71,779.45	2	1
North Beach	240012	$79,410.58	$0.00	$79,410.58	2	1
North Beach	240012	$11,453.75	$0.00	$11,453.75	2	1
North Beach	240012	$95,663.78	$15,794.63	$111,458.41	3	1
	Total:	**$2,588,911.82**	**$301,051.86**	**$2,889,963.68**	**135**	**55**
Source: FEMA, 2023						

Table 24 - Summary of Type of Repetitive Loss Properties by Municipality

Summary of Type of Repetitive Loss Properties by Municipality					
Municipality	**Type**				
	Non-Residential	**2-4 Family**	**Single Family**	**Condo**	**Other Residential**
Calvert County	3	1	36	0	0
Chesapeake Beach (Town)	2	0	1	0	0
North Beach (Town)	0	0	14	0	0
Source: FEMA, 2023					

Table 25 - Severe Repetitive Loss Properties

Severe Repetitive Loss Properties						
Community Name	**Community Number**	**Cumulative Building Payments**	**Cumulative Contents Payments**	**Sum of Total Paid**	**Losses**	**Properties**
Calvert County	240011	$87,654.99	$0.00	$87,654.99	4	1
Chesapeake Beach	240100	$371,135.10	$155,784.49	$526,919.59	12	1
Total:		**$458,790.09**	**$155,784.49**	**$614,574.58**	**16**	**2**
Source: FEMA, 2023						

4.3.5.4 Future Occurrence

Flooding is a frequent problem throughout the State of Maryland. Calvert County will certainly be impacted by flooding events in the future, as Calvert County experiences some degree of flooding annually. The threat of flooding is compounded in the late winter and early spring months, as melting snow can overflow streams, creeks, and tributaries, increasing the amount of groundwater, clogging stormwater culverts and bridge openings. Another factor that can increase the risk of flooding in Calvert County is the risk of high-tide flooding. The NFIP recognizes the 1% annual chance flood, also known as the base flood of a one-hundred-year flood, as the standard for identifying properties subject to federal flood insurance purchase requirements. A 1% annual chance flood is a flood which has a 1% chance of occurring in a given year or is likely once every one-hundred years. The digital flood insurance maps (DFIRMs) are used to identify areas subject to the 1% annual chance of flooding.

A property's vulnerability to a flood is dependent upon its location in the floodplain. Properties along the banks of a waterway are the most vulnerable. The property within the floodplain is broken into sections depending on its distance from the waterway. The ten-year flood zone has a 10% chance of being flooded every year. However, this label does not mean that this area cannot flood more than once every ten years. This label simply designates the probability of a flood of this magnitude every year. Further away from this area is the fifty-year floodplain. This area includes all of the ten-year floodplain plus additional property. The probability of a flood of this magnitude occurring during a one-year period is 2%. A summary of flood probability is shown in *Table 26 – Flood Probability Summary*.

Table 26 - Flood Probability Summary

Flood Probability Summary	
Flood Recurrence Intervals	**Annual Chance of Occurrence**
10-year	10.00%
50-year	2.00%
100-year	1.00%
500-year	0.20%
Source: FEMA, 2009	

The future occurrences of flooding, flash flooding, and ice jam flooding in Calvert County are expected to increase due to the rate of climate change in Maryland, and the world. Climate change will include ocean temperature rise, which result in more intense hurricane and tropical storm seasons in the Atlantic Ocean. This intensity could result in an increase in the number of hurricanes and tropical storms that could impact Maryland and Calvert County. These hurricanes and tropical storms could result in a large volume of precipitation occurring over a short period of time, resulting in a flood or flash flood event. It is important to note that these impacts are the secondary result of other hazards, increased by climate change, that could result in flooding events.

4.3.5.5 Vulnerability Assessment

Riverine and Stream Flooding

Calvert County is vulnerable to stream and river flooding on an annual basis. Flooding puts the entire population at some level of risk, whether through flooding of homes, businesses, places of employment, roadways, sewers, and water infrastructure. Flooding can cause significant power outages and poor road conditions that can lead to heightened transportation accident risk.

County community lifelines are the most vulnerable buildings and services when riverine and stream flooding is considered. Community lifeline facilities are facilities that, if damaged, would present an immediate threat to life, public health, and safety. Facilities that use and store hazardous materials pose a potential threat to the environment during flooding events if flooding causes a leak, inundation, or equipment failure. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Calvert County, with vulnerable structures and community lifeline facilities that are located within the special flood hazard area.

Table 27 – Expected Damage to Essential Facilities (HAZUS) illustrates the estimated damage levels to certain essential facilities based on classifications in the HAZUS General Building Stock. No critical facilities or essential facilities will be moderately or substantially damaged by the proposed flood event.

Table 27 - Expected Damage to Essential Facilities (HAZUS)

Expected Damage to Essential Facilities				
Classification	**Number of Facilities**			
	Total:	**At Least Moderate:**	**At Least Substantial:**	**Loss of Use:**
Emergency Operations Center	1	0	0	0
Fire Stations	8	0	0	0
Hospitals	1	0	0	0
Police Stations	3	0	0	0
Schools	32	0	0	0

Table 28 - County Structures Within Special Flood Hazard Area shows the number of site structure address points within the Special Flood Hazard Area as well as the community lifeline facilities. This information was compiled using the Special Flood Hazard Area and GIS data provided by the Calvert County GIS Department.

Table 28 - County Structures Within Special Flood Hazard Area

County Structures Within Special Flood Hazard Area		
Municipality	**Site Structure Address Points Within Flood Area**	**Community Lifelines within Flood Area**
Chesapeake Beach	124	0
North Beach	99	2
Totals:	**223**	**2**

Table 29 – Community Lifeline Facilities Additional Information illustrates the additional information including name, the municipality, and the type of facility for each community lifeline facility that falls within the Special Flood Hazard Area for Calvert County. This information was compiled using Calvert County's GIS information with the assistance of the Calvert County GIS Department.

Table 29 - Community Lifeline Facilities Additional Information

Community Lifeline Facilities Additional Information		
Type of Facility:	**Facility Name:**	**Municipality:**
Community Lifelines		
Grocery	Chesapeake's Bounty	North Beach
	North Beach Farmer's Market	North Beach

Flash Flooding

Flash flooding is a common occurrence in Calvert County and can occur anywhere in the county. A large portion of flash flooding occurs in populated areas that have increased impervious ground cover. During the risk assessment process, numerous resources were utilized to determine flash flooding locations in Calvert County. Municipalities were asked to identify locations within the municipality that were prone to frequent flash flooding. The National Climatic Data Center was also queried to determine flash flood vulnerable areas. This data reflected in *Table 22 – Past Flood and Flash Flood Events* above.

Locations that are identified as vulnerable to flash flooding in Calvert County are as follows:

- Town of North Beach
- Owings

Although the above locations were identified as vulnerable areas in Calvert County, they are not the only locations that are vulnerable to flash flooding. The Calvert County Hazard Mitigation Team will continue to work with municipalities to identify vulnerable flash flooding locations and identify vulnerable populations and community lifelines.

Impact of flooding, flash flooding, and nuisance flooding on historic properties in Calvert County

All of the historic properties in Calvert County are at an increased vulnerability to flooding, flash flooding, and nuisance flooding. High-tide flooding could occur in the 500ft area near the coastline that could affect the following historic properties: Chesapeake Beach Railway Station, Cove Point Lighthouse, Drum Point Lighthouse, Grahame House, J. C. Lore Oyster House, La Veille, Morgan Hill Farm, Patterson Archaeological and Historic District, and the Preston-on-the-Patuxent.

Only one of these properties is located in an incorporated municipality and that is Chesapeake Beach Railway Station, located in the town of Chesapeake Beach.

All of the population of Calvert County, including the unserved and the underserved populations, are at an increased vulnerability to flooding hazards. The municipalities in Calvert County directly interface with the regulatory flood boundaries in county. Unserved and underserved populations have the potential to be more vulnerable to flooding hazards in Calvert County. Homeless, unsheltered, and displaced persons would not have housing or homes to use as a shelter in the event of a flooding hazard. Those populations also may not have easy access to warning systems or alerts for flash flooding hazards. All of the county could be at increased vulnerability, specifically any populations located on the Patuxent River or the Chesapeake Bay.

Systems in Calvert County are at increased vulnerability to flooding hazards. All of the utilities in Calvert County could be adversely impacted by very specific flooding and flash flooding events. Areas in Calvert County that are directly adjacent to cliffs or steep areas have the potential for flash flooding to wash out or expose utility systems. Areas of the county have seen septic utilities exposed or impacted from flooding events, including the areas of Breezy Point and Plum Point. Utilities may be damaged or destroyed from a flooding event, or from a cascading hazard from flooding events. Major flooding could cause an issue in the delivery of services, including electricity, to the citizens and residents of Calvert County.

While flooding does not typically adversely affect natural areas, a comprehensive vulnerability assessment was completed for natural areas in Calvert County, including public recreation areas, state parks, state game lands, and any other outdoor or natural area resources.

The following areas directly intersected with areas of the Special Flood Hazard Area (SFHA) for Calvert County:

- Battle Creek Cyprus Swamp Sanctuary
- Calvert Cliffs State Park
- Flags Pond Nature Park
- King's Landing Park
- Lynwood T. Kellam Memorial Park

Not all of these locations will be impacted by every flooding event in Calvert County, but at least some of the areas listed above will be impacted due to their close proximity to the Special Flood Hazard Area (SFHA).

Impacts of flooding, flash flooding, and ice jam flooding can also be influenced by population change. As seen in *Table 2 – Population Change in Calvert County*, the Town of Chesapeake and the Town of North Beach have experienced population growth between the 2010 decennial census and the 2020 decennial census. Based on this information, it can be speculated that these two municipalities have an increased vulnerability to flooding, flash flooding, and ice jam flooding hazards, since 2010. This increased vulnerability is due to more potential development and that development encroaching on high vulnerability areas for Calvert County, including near the Special Flood Hazard Area.

Land use is a factor that has the potential to impact the vulnerability to flooding, flash flooding, and ice jam flooding in Calvert County. Land use, in the form of a built environment, such as residential and commercial expansion, especially in the Special Flood Hazard Area or areas directly adjacent, could increase the severity impact of these hazards. The change of land use from areas of easy infiltration of groundwater to impervious surfaces can increase the severity and the frequency of flash floods, increasingly in areas where flash floods have occurred in the past. An influx of people, commercial enterprises, and infrastructure development also increases the vulnerability of areas to flooding, flash flooding, and ice jam flooding.

4.3.6. Hail

4.3.6.1 Location and Extent

Hail is possible with most thunderstorms. It is produced by cumulonimbus (storm clouds) and within two nautical miles of the parent storm. In the form of solid precipitation, hail is produced when an ice crystal collects additional water in the lower part of the storm but is pushed upward by the storm's updraft. The liquid water freezes in the upper regions of the storm, making the ice crystal larger, this is also known as a hailstone. The hail will continue to grow in this manner until its weight exceeds the force of the updraft. Hailstones can take the shape of balls or irregular lumps of ice.

Hailstorms are not limited to any particular geographic area of the county. Neither prediction of the duration of the storm nor the extent of area affected by such an occurrence can be predicted.

4.3.6.2 Range of Magnitude

Hailstones can measure between 0.2 inches to six inches in diameter. The METAR (a format for reporting weather information, predominately used by pilots) reporting code for hail 0.20 inches or greater is GR, while smaller hailstones are coded GS. Hail that is larger than 0.80 inches are usually considered large enough to cause damage. The US National Weather Service will issue severe thunderstorm warnings when hail that is 1 inch or greater in diameter is expected.

National Oceanic and Atmospheric Administration Skywarn program requests trained Skywarn Spotters measure hail with a ruler, but if one is not available, related terms can be used. See *Table 30 - Size of hail in related terms*. Hail should only be measured when it is safe to do so.

Table 30 - Size of hail in related terms

Size of hail in related terms	
Related item	**Size of hail**
BB	Less than 1/4"
Pea	1/4"
Dime	7/10"
Penny	3/4"
Nickel	7/8"
Quarter	1"
Half Dollar	1 1/4"
Walnut or ping-pong ball	1 1/2"
Golf ball	1 3/4"
Lime	2"
Tennis ball	2 1/2"
Baseball	2 3/4"
Large apple	3"
Softball	4"
Grapefruit	4 1/2"

Environmental and other impacts from hailstorms range from:

- Crop production damage;
- Flooding caused by accumulation of hail that blocks drains;
- Loss of electric power;
- Trees brought down;
- Flash flooding; and,
- Mudslides.

4.3.6.3 Past Occurrence

In the 1960's the National Weather Service (NWS) developed the Skywarn® program. Skywarn® has trained weather spotters who provide reports of severe weather to NWS. These reports assist meteorologists to make life-saving warning decisions. Concerned citizens, amateur radio operators, truck drivers, emergency management personnel and others volunteer their time and energy to report hazardous weather impacting their communities.

Even with data from Doppler radar, satellite, and surface weather stations, NWS technology can't detect every instance of weather such as hail. So, reports from Skywarn® volunteers are a vital service for making warnings to those in the storm's path.

NOAA's National Weather Service storm prediction center reports on hail events for Calvert County are detailed in *Table 31 – National Weather Service Hail Reports*.

Table 31 - National Weather Service Hail Reports

National Weather Service Hail Reports			
Date	**Time**	**Location**	**Size (inches)**
10/09/1962	06:00	Calvert County	0.75
04/01/1993	17:45	Calvert County	0.88
09/26/1994	16:25	Calvert County	0.75
07/15/1996	15:07	Prince Frederick	2.00
03/29/1997	13:30	Prince Frederick	1.75
06/15/1998	17:45	St. Leonard	1.75
06/15/1998	18:55	Lusby	0.75
04/09/1999	17:30	Solomons	1.00
04/09/1999	17:30	Island Creek	1.25
04/09/1999	17:30	Buena Vista	1.50
04/23/1999	15:40	Island Creek	1.00
04/23/1999	15:45	Prince Frederick	1.50
04/23/1999	16:42	Lusby	0.75
04/23/1999	16:42	Solomons	1.50
04/21/2000	17:15	Dunkirk	1.00
07/16/2000	13:30	Huntingtown	0.88
04/28/2002	18:25	Bowens	1.75
04/28/2002	18:35	Prince Frederick	1.75

National Weather Service Hail Reports			
Date	**Time**	**Location**	**Size (inches)**
05/05/2004	17:35	Prince Frederick	0.88
04/23/2005	16:23	Chesapeake Beach	0.75
07/16/2007	15:32	St. Leonard	1.00
05/31/2008	14:05	Huntingtown	1.00
05/31/2008	14:42	Stoakley	0.75
06/22/2008	17:47	Kenwood Beach	0.75
06/22/2008	18:34	Dunkirk	0.75
07/04/2008	17:56	Barstow	0.75
06/02/2009	17:13	Island Creek	0.88
06/02/2009	17:19	St. Leonard	0.75
06/02/2009	17:20	St. Leonard	0.75
06/02/2009	17:27	Lusby	0.75
06/26/2009	19:59	Bowens	0.75
05/14/2010	18:45	Barstow	1.00
08/21/2011	16:07	Breezy Pt	1.00
06/22/2012	15:43	Dares Beach	1.00
05/22/2014	16:50	Solomons	1.75
05/02/2016	19:05	Chaneyville	1.75
05/23/2016	16:54	Chesapeake Beach	1.00
02/25/2017	15:30	Paris	1.25
02/25/2017	15:35	Chesapeake Beach	1.00
04/21/2017	18:49	North Beach	1.00
05/12/2018	21:15	Mutual	1.00
06/29/2019	14:39	Breezy Pt	1.00
06/29/2019	19:30	Sunderland	1.00
05/16/2022	16:02	Dunkirk	1.00
05/16/2022	16:03	Lower Marlboro	1.50
05/16/2022	16:05	Chaneyville	1.00
05/16/2022	16:07	Huntingtown	2.25
05/16/2022	16:12	North Beach	1.00
05/16/2022	16:13	Breezy Pt	3.00
Source: NWS, 2023			

It should be noted that all occurrences of hail in Calvert County may not have been recorded in the table above. This is due to lack of reports to the NWS, either because the hail happened at locations uninhabited, during overnight hours, or residents that observed the hail were not Skywarn® spotters.

4.3.6.4 Future Occurrence

Hailstorms are associated with thunderstorms and should be considered highly likely for Calvert County. While death and severe injury are rarely attributed to hailstorms, they still pose a threat to unsheltered peoples, vehicles, livestock, crops, and even structures, so vulnerability to the hazard should continue to be monitored. Calvert County should expect to see moderate hailstorm weather events, and the hazards which they entail, perpetuate.

Climate change can influence hailstorms through several methods. Rising global temperatures can lead to increased atmospheric moisture, providing more fuel for severe thunderstorms that spawn hail. Changes in atmospheric circulation patterns may also contribute, altering the conditions conducive to hail formation. Warmer temperatures can elevate the freezing level in the atmosphere, allowing hailstones to grow larger before reaching the ground. Additionally, shifts in wind patterns may affect the distribution and intensity of storms, influencing hailstorm frequency and severity. Climate change-induced changes in precipitation patterns may also impact the availability of supercooled water needed for hailstone formation. Overall, the complex interplay of atmospheric factors influenced by climate change contributes to the alteration of hailstorm characteristics, potentially leading to more intense and frequent hail events with broader implications for agriculture, infrastructure, and communities.

4.3.6.5 Vulnerability Assessment

Automobiles, aircraft, skylights, livestock, and farmers' crops can all be seriously damaged by hail. That National Weather Service estimates that large hailstorms events cause over one-billion USD in damages to agriculture every year. In Calvert County there has been a recorded $50.00 in hail damage to crops and $106,000.00 in vehicle damage. Calvert County's farmland can be negatively impacted by hail and hailstorm events. With a total of 280 farms located in Calvert County as reported in the 2017 Census of Agriculture, and with a total market value of $6,322,000.00, hail damage could cause economic strain on the county, the local municipalities and Town Centers, and the residents. A hail event has the potential to impact 25,152 acres of land in Calvert County that is held in farms, or approximately 18% of the total land area of the county. Crop yields that could be negatively impacted by a potential hail event are worth approximately $5,701,000.00 based on 2017 information. The most common crop products that would be impacted are soybeans, corn for grain, forage (hay/haylage) and wheat.

The damage that a hail event could cause to cars, trucks, and transportation systems in Calvert County must also be examined in greater detail. The Maryland Department of Transportation's (MDOT) Motor Vehicle Administration reports that there are approximately 99,843 registered motor vehicles in Calvert County. All of these vehicles, as well as any people traveling through the county during any time of day could be damaged by a hail or hailstorm event if they are not under cover. There are no records of how many housing units in Calvert County have garages, but any cars in properly constructed garages or outbuildings would be secure from damaging hail.

Roofs can also be damaged by hail, although it most likely will go undetected until structural damage is seen, such as leaks and cracks. Although it is rare, hail has been known to cause concussions or fatal head traumas to humans. To alleviate damages from hail, automobiles could be placed in garages, grounded aircraft could be placed in a hanger, livestock and people moved inside structures during the storm. Unfortunately crops, skylights, roofs, and flying aircraft are unable to be protected from hail.

Impact of hail on historic properties in Calvert County

All of the historic properties that are located in Calvert County are at an increased vulnerability to hail and hailstorms. The exterior of these structures in Calvert County are relatively resilient to hail but the greatest impacts to these locations would be damage to roofs and windows. No historic property would be less vulnerable, but the impacts would depend on the location of the hailstorm and where that hailstorm is traveling.

Hailstorms can disproportionately impact underserved, unserved, and socially vulnerable populations, exacerbating existing inequalities. Vulnerable communities often lack resources to fortify homes or vehicles against hail damage, resulting in severe property losses. Unsheltered populations within Calvert County have the highest vulnerability to hailstorms due to being directly exposed to the related weather events that hailstorms may bring.

As seen in *Table 2 – Population Change in Calvert County*, the Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. Based on this information, it can be speculated that these municipalities may have an increased vulnerability to hailstorms, since 2010, due to the increase in population.

Land use changes, such as urbanization and deforestation, can indirectly impact hailstorms. Urban heat islands, created by increased impervious surfaces, may alter local temperature patterns. Changes in surface roughness due to urban development can influence wind dynamics. Additionally, variations in land cover affect local atmospheric moisture levels, potentially influencing the intensity and dynamics of thunderstorms conducive to hail formation.

4.3.7. Hurricane and Tropical Storm

4.3.7.1 Location and Extent

Calvert County does not have any open-ocean coastline areas. However, the impacts from coastal storms such as tropical storms and hurricanes can expand inland. Tropical depressions are cyclones with maximum sustained winds of less than 39 miles per hour (mph). The system becomes a tropical storm when the maximum sustained winds reach between 39 and 74 miles per hour. When wind speeds exceed 74 mph, the system is considered a hurricane. Tropical storms impacting Calvert County develop in tropical or sub-tropical waters found in the Atlantic Ocean, Caribbean Sea, or Gulf of Mexico. Another type of tropical storms is the nor'easter, which is a large cyclone that rotates clockwise and is typically associated with the Atlantic Ocean and the East Coast of the United States between North Carolina and Massachusetts. The name nor'easter comes from the direction that the strongest winds typically blow from the cyclone.

While Calvert County is located on the East Coast of the United States, and the Chesapeake Bay, tropical storms can track inland and cause heavy rainfall and strong winds. Calvert County is on the East Coast region, designated by FEMA, as being Hurricane-Susceptible (see *Figure 20 – Maryland Wind Zones*). Calvert County falls within wind zone II as shown in *Figure 20 – Maryland Wind Zones*. Zone II suggests that shelters and critical facilities should be able to withstand winds that range up to 160 MPH. Tropical storms and hurricanes are regional and seasonal events that can impact very large areas that are hundreds to thousands of miles across over the life of the storm. Hurricane and tropical storm seasons are typically from June to November. All communities within Calvert County are equally subject to the impacts of hurricanes and tropical storms that track near the county. Areas in Calvert County which are subject to flooding, wind, and winter storm damage are particularly vulnerable.

4.3.7.2 Range of Magnitude

Table 32 - Saffir-Simpson Scale

Saffir-Simpson Hurricane Scale		
Category	Wind Speed	
	mph	knots
5	≥156	≥135
4	131-155	114-134
3	111-130	96-113
2	96-110	84-95
1	74-95	65-83
Non-Hurricane Classifications		
Tropical Storm	39-73	34-64
Tropical Depression	0-38	0-33

The impact tropical storm or hurricane events have on an area is typically measured in terms of wind speed. Flood damage results from intense precipitation and wind, typically from coastal storms, which impact Calvert County. Expected damage from hurricane force winds is measured using the Saffir-Simpson Scale (*Table 32 – Saffir-Simpson Scale*). The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential. Categories three, four, and five are classified as "major" hurricanes, but category one and two storms can contain potential significant storm surge. Category one storms result in very dangerous winds with some damage, while category two storms results in extremely dangerous winds with extensive damage. Category three storms result in devastating damage and category four/five storms result in catastrophic damage. Although major hurricanes comprise only 20% of all tropical cyclones making landfall, they account for over 70% of the damage in the United States. While hurricanes can cause high winds and associated impacts, it is also important to recognize the potential for flooding events during hurricanes, tropical storms, and nor'easters. In Calvert County wind impacts from tropical events include downed trees and utility poles to cause utility interruptions. Mobile home, because they may not be well-anchored, have a greater potential to be impacted by high winds. Additionally, these storms can produce high volumes of rainfall that cause flash flooding which can be followed by stream and riverine flooding. The risk assessment and associated impact for flooding events is included in Section 4.3.5.

4.3.7.3 Past Occurrence

Table 33 – History of Coastal Storms Impacting Calvert County lists all coastal storms that have impacted Calvert County from 1999 to 2020. *Figure 21 – Historic Tropical Storms/Hurricanes in Maryland* identifies some past hurricanes that had an inland path through Maryland.

Hurricane Irene and Tropical Storm Lee impacted and caused damage to Calvert County. Although they were separate events, Hurricane Irene and Tropical Storm Lee together caused significant rainfall in Calvert County due to how close the events took place. First, Tropical Storm Lee caused significant flooding in the central and eastern counties in Maryland with wind damage that caused utility outages for 1-2 days. Then, Hurricane Irene caused additional flooding with utility interruptions from 5-8 days. Many flooding events took place in the county during this time.

Table 33 - History of Coastal Storms Impacting Calvert County

History of Coastal Storms Impacting Calvert County			
Year	**Name**	**Category at Time of Calvert County Impact**	**Wind Speed at Time of Calvert County Impact in Knots (kt)**
2020	Zeta	Extra-Tropical Storm	45
2020	Isaias	Tropical Storm	60
2008	Hanna	Tropical Storm	45
2006	Ernesto	Extra-Tropical Storm	40
2005	Cindy	Extra-Tropical Storm	25
2004	Jeanne	Tropical Depression	25
2004	Ivan	Tropical Depression	20
2000	Gordon	Extra-Tropical Storm	25
1963	Unnamed 1963	Tropical Storm	40
1955	Connie	Tropical Storm	55
1945	Unnamed 1945	Extra-Tropical Storm	35
1944	Unnamed 1944	Tropical Storm	35
1943	Unnamed 1943	Tropical Storm	45
1929	Unnamed 1929	Extra-Tropical Strom	50
1899	Unnamed 1899	Extra-Tropical Storm	50
1893	Unnamed 1893	Tropical Storm	40

History of Coastal Storms Impacting Calvert County			
Year	Name	Category at Time of Calvert County Impact	Wind Speed at Time of Calvert County Impact in Knots (kt)
1888	Unnamed 1888	Tropical Storm	35
1886	Unnamed 1886	Tropical Depression	30
Source: NOAA, 2023			

4.3.7.4 Future Occurrence

Although hurricanes and tropical storms can cause flood events consistent with 100 and 500-year flood levels, the probability of occurrence of hurricanes and tropical storms is measured relative to wind speed. *Table 34 – Annual Probability of Wind Speeds* shows the annual probability of winds that reach the strength of tropical storms and hurricanes in Calvert County and the surrounding areas based on a sample period of forty-six years. According to FEMA, there is a low probability each year that Calvert County will experience winds from coastal storms that could cause minimal to moderate damages (*Table 34 – Annual Probability of Wind Speeds*). The potential future impacts from a tropical storm or hurricane will be approximately .34% annual chance of occurring based off of previous occurrences. This will likely increase as climate change impacts increase and cause more frequent storms in Calvert County. The probability of winds exceeding 118 mph is less than 0.1% annually.

Table 34 - Annual Probability of Wind Speeds

Annual Probability of Wind Speeds		
Wind Speed (mph)	Saffir-Simpson Scale	Annual Probability of Occurrence (%)
45-77	Tropical Storms// Category 1 Hurricane	91.59
78-118	Category 1 to 2 Hurricanes	8.32
119-138	Category 3 to 4 Hurricanes	.0766
139-163	Category 4 to 5 Hurricanes	.0086
164-194	Category 5 Hurricanes	.00054
195+	Category 5 Hurricanes	.00001
Source: FEMA, 2000		

There has been an increase in North Atlantic hurricane activity since the 1970s with locations of peak intensity tropical cyclones migrating poleward coinciding with tropics expansion. An index potential hurricane destructiveness suggests an increase over the past thirty years. Variability in tropical cyclone activity in the Atlantic is due to natural variability in ocean circulation, volcanic eruptions, and Saharan dust, as well as climate change resulting from greenhouse gases and sulfate aerosols.

Climate change is causing atmospheric temperatures to rise, which corresponds to a rise in ocean surface temperatures, resulting in warmer and moister conditions where tropical storms develop. However, the relationship between climate change and hurricanes can be complex due to the many other factors that are associated with hurricane development which include wind shear and air pollution. Warmer oceans store more energy and are capable of fueling stronger storms and it is projected that Atlantic hurricanes will become more intense and produce more precipitation as ocean surface temperatures rise. The storms associated with the tropical storms/hurricanes can also linger around for a longer period of time in a given place due to the climate change which enhances destructive impacts in the future. Other possible connections of hurricanes in near future related to climate change are the length of hurricane season and seeing more hurricanes earlier or later than usual hurricane season. There are expected to be more category four and five hurricanes in the Atlantic and the hurricane season may be elongated, all which impact the future of Calvert County.

4.3.7.5 Vulnerability Assessment

The impacts of climate change are tangible and hazardous realities. Tropical storms tracking nearby Calvert County can not only cause high winds, but also heavy rains to occur. A vulnerability assessment for hurricanes and tropical storms focusses on the impacts of flooding and severe winds. Flooding associated with hurricanes/tropical storms can occur in areas throughout Calvert County which can cause damage to buildings and infrastructure. The assessment for flood-related vulnerability is addressed in Section 4.3.5.5 and a discussion of wind related vulnerability is addressed in Section 4.3.13.5. Due to the impact of hurricanes and tropical storms, the vulnerability for Calvert County is moderate.

Tropical storms also introduce the potential for buildings and structures to be damaged by falling trees and wind swept debris. Significant damage due to falling trees and wind swept debris can cause power outages if the utility systems become damaged. For example, winds associated with Tropical Storm Isaias resulted in an EF-1 tornado that caused multiple downed trees, including two that caused structural damage to different homes. More discussion on these tornado impacts can be found in section 4.3.13.3.

Impact of hurricanes and tropical storms on historic properties in Calvert County

All of the historic properties that are located in Calvert County are at an increased vulnerability to hurricanes and tropical storms.

As seen in *Table 2 – Population Change in Calvert County*, The Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. Based on this information, it can be speculated that these municipalities may have an increased vulnerability to hurricane and tropical storms, since 2010, due to the increase in population.

Land use is a factor that has the potential to impact hurricane and tropical storm severity. Land use, in the form of a built environment, such as residential expansion, can cause hurricane impact severity to increase. This impact severity increases because as the built environment expands and becomes more complex, the impact the event will have on that area also increases. This is due to an influx of people, infrastructure, and critical infrastructure and community lifelines in harm's way. Natural land use areas will weather hurricanes and tropical storms more efficiently than built environments, like low, medium, and high density residential and commercial areas. Agricultural areas will also be less impacted and vulnerable to hurricane events than built up or developed areas.

Natural areas and resources will be impacted by hurricane and tropical storms from cascading hazards. Flooding is the most likely impact from a hurricane or tropical storm event. The natural areas of Calvert County, including those outlined in the above sections and the community profile will be moderately impacted. Utility systems also will be at an increased vulnerability to hurricanes and tropical storms in Calvert County. Significant impacts from past hurricanes and tropical storms have occurred in relation to utility interruptions and power outages. This could also lead to issues with injuries from downed poles and wires.

Figure 20 - Maryland Wind Zones

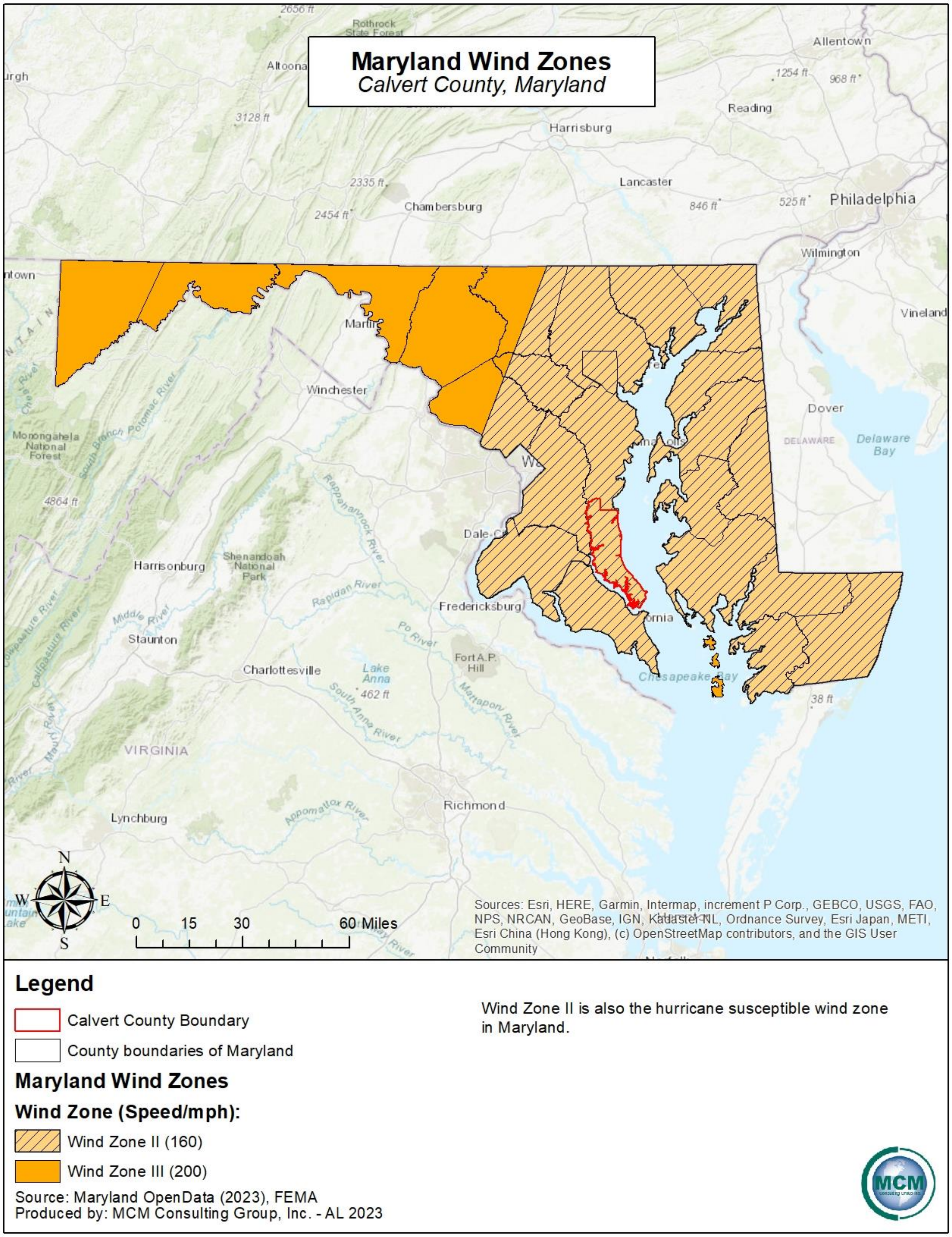
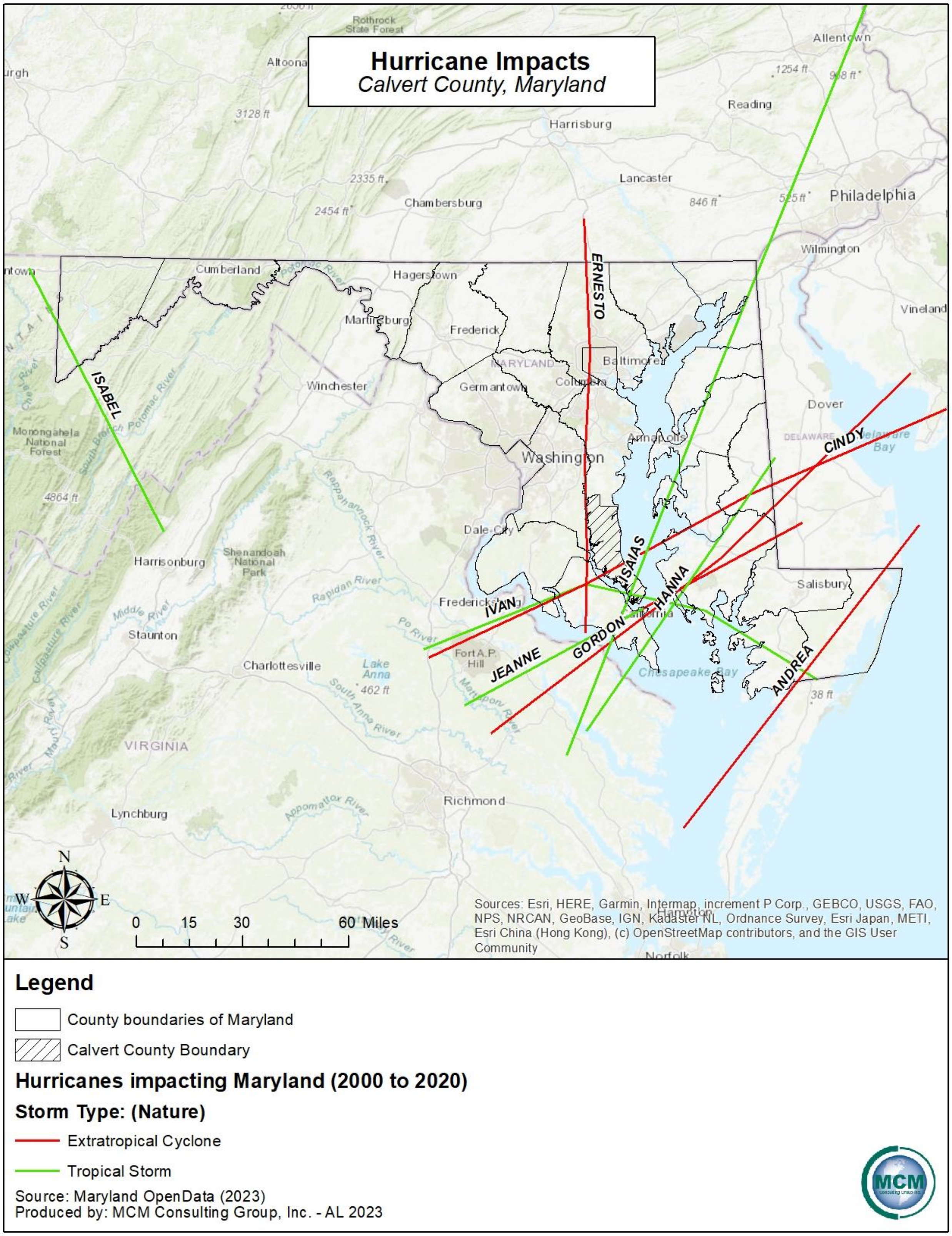


Figure 21 - Historic Tropical Storms/Hurricane in Maryland



4.3.8. Invasive Species

4.3.8.1 Location and Extent

An invasive species is a species that is not indigenous to a given ecosystem and that, when introduced to a non-native environment, tends to thrive. The spread of an invasive species often alters ecosystems, which can cause environmental and economic harm and pose a threat to human health. Often, an invasive species spreads and reproduces quickly. Invasive species are not limited to organisms that come from a foreign country. Invasive species can come from a different region in the United States. The main instigator of invasive species is human activity. Either intentionally or unintentionally, other species may accompany people when they travel, introducing the stowaway species to a novel ecosystem. In a foreign ecosystem, a transported species may thrive, potentially restructuring the ecosystem and threatening its health. Common pathways for invasive species introduction to Maryland include but are not limited to:

- Contamination of internationally traded products
- Hull fouling
- Ship ballast water release
- Discarded live fish bait
- Intentional release
- Escape from cultivation
- Movement of soil, compost, wood, vehicles or other materials and equipment
- Unregulated sale of organisms
- Smuggling activities
- Hobby trading or specimen trading

Invasive species are broken into two major categories: aquatic and terrestrial invasive species. The specifications are below:

Aquatic Invasive Species (AIS) are nonnative invertebrates, fishes, aquatic plants, and microbes that threaten the diversity or abundance of native species, the ecological stability of the infested waters, human health and safety, or commercial, agriculture, or recreational activities dependent on such waters.

Terrestrial Invasive Species (TIS) are nonnative plants, vertebrates, arthropods, or pathogens that complete their lifecycle on land instead of in an aquatic environment and whose introduction does or is likely to cause economic/environmental damage or harm to human health.

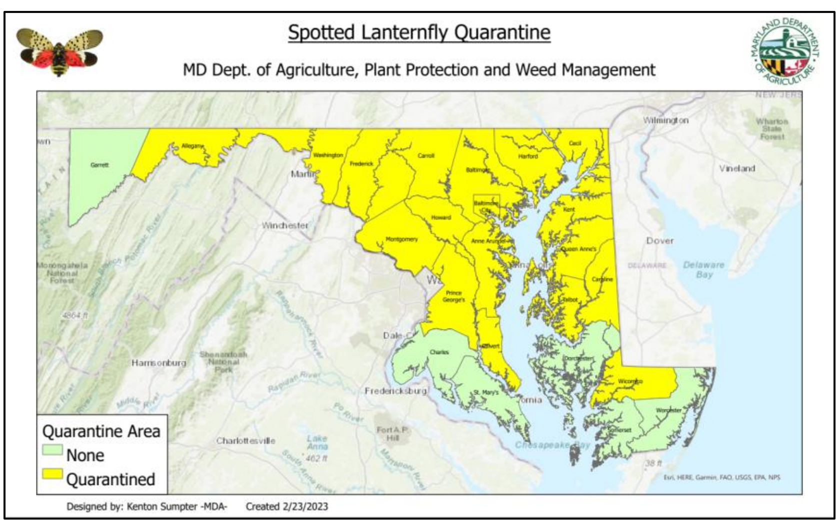
The location and extent of invasive threats is dependent on the preferred habitat of the species, as well as the species' ease of movement and establishment. For example, kudzu vine is an aggressive vascular plant. With wide ecological parameters and ease of spread, the vine is a more widespread invasive species threat. Other species' spread, such as the spotted lantern fly, has been limited by state agency activity. *Table 35 - Prevalent Invasive Species* lists invasive species that have been found in Calvert County.

4.3.8.2 Range of Magnitude

The magnitude of invasive species threats ranges from nuisance to widespread killer. Some invasive species are not considered agricultural pests, and do not harm humans or cause significant ecological problems. For example, Brown Marmorated Stink Bugs are not considered to be an agricultural pest and do not harm humans. Other invasive species can have many negative impacts and cause significant changes in the composition of ecosystems. For example, the Emerald Ash Borer creates a 99% mortality rate in any ash tree it infects. The aggressive nature of many invasive species can cause significant reductions in biodiversity by crowding out native species. This can affect the health of individual host organisms as well as the overall well-being of the affected ecosystem. The Emerald Ash Borer is not significantly prevalent in Calvert County, and the hemlock woolly adelgid is more common in the western parts of Maryland.

Another example of an invasive species is the Spotted Lanternfly. The Spotted Lanternfly is a harmful invasive species which feeds on plants, damaging or destroying them. This can negatively impact the areas of Maryland known for outdoor scenery and activities. According to the Maryland Department of Agriculture, the Spotted Lanternfly is a significant threat to Maryland agriculture, landscapes, and natural ecosystems, including grape, tree-fruit, hardwood, and nursery industries, outdoor recreation, and biodiversity. The Spotted Lanternfly was found in Cecil County and Harford County in 2019. However, the Spotted Lanternfly is undoubtedly continuing to spread. The Maryland Department of Agriculture estimates that seventeen counties and the city of Baltimore are on the quarantine list for Spotted Lanternfly, as of 2023. *Figure 22 – Maryland Spotted Lanternfly Infestation* illustrates the counties in Maryland that are considered to be in the quarantine zone for this pest.

Figure 22 - Maryland Spotted Lanternfly Infestation



The magnitude of an invasive species threat is generally amplified when the ecosystem or host species is already stressed, such as in times of drought. The already weakened state of the native ecosystem causes it to succumb to an infestation more easily. A worst-case example could be an invasive species causing reduced biodiversity, increased wildfire potential, and thermal harm to small stream cold water fisheries and habitats.

4.3.8.3 Past Occurrence

Invasive species have been entering Maryland since the arrival of European settlers, but not all occurrences required government action. Calvert County is known for its great number of geographic features. There are a large number of parks and natural areas in Calvert County, split into three districts, northern, central and southern. The northern district consists of the Dunkirk District Park, the Twin Shields Recreation Area, and the Ward Farm park. The central district contains the Battle Creek Cypress Swamp, Flag Ponds Nature Park, American Chestnut Land Trust, Grays Road Dog Park, the Hallowing Point Park, the King Park, and the Marley Run Recreational Area. Finally, the southern district consists of the Calvert Cliffs State Park, Hellen Creek Preserve, BGE Recreation Area including BGE Field, the Cove Point Park, the Solomons Town Center Park, and Grover Field. Due to the vast area of forests, there are many invasive terrestrial species that have been widespread in Calvert County that are common problems throughout the state.

Many of the extreme problematic species have been around for many years. *Table 35 - Prevalent Invasive Species* lists problematic non-native species that are established in Calvert County. While all species listed here are not native to Calvert County, those that were observed the most often have a higher number of records.

Table 35 - Prevalent Invasive Species

Prevalent Invasive Species		
Common Name	**Scientific Name**	**Number of Records**
corn earworm, tomato fruitworm	Helicoverpa zea	98
European corn borer	Ostrinia nubilalis	56
gray mold	Botrytis cinerea	50
white clover	Trifolium repens	21
tree-of-heaven	Ailanthus altissima	18
wine raspberry	Rubus phoenicolasius	16
Japanese stiltgrass	Microstegium vimineum	16
multiflora rose	Rosa multiflora	12
henbit	Lamium amplexicaule	11
Asiatic dayflower	Commelina communis	11
hemlock woolly adelgid	Adelges tsugae	10
Japanese honeysuckle	Lonicera japonica	10

Prevalent Invasive Species		
Common Name	**Scientific Name**	**Number of Records**
spongy moth (formerly gypsy moth)	Lymantria dispar	9
southern pine beetle	Dendroctonus frontalis	9
multicolored Asian lady beetle	Harmonia axyridis	8
buckhorn plantain	Plantago lanceolata	8
American bullfrog	Lithobates catesbeianus	7
common chickweed	Stellaria media	6
ground ivy	Glechoma hederacea	4
red clover	Trifolium pratense	4
spotted spurge	Euphorbia maculata	3
white mulberry	Morus alba	3
emerald ash borer	Agrilus planipennis	3
fall armyworm	Spodoptera frugiperda	3
English ivy	Hedera helix	2
dogwood anthracnose	Discula destructiva	2
eastern redcedar	Juniperus virginiana	2
common mullein	Verbascum thapsus	2
common pokeweed	Phytolacca americana	2
common reed	Phragmites australis	2
Callery pear (Bradford pear)	Pyrus calleryana	2
border privet	Ligustrum obtusifolium	2
autumn olive	Elaeagnus umbellata	2
hairy bittercress	Cardamine hirsuta	2
coltsfoot	Tussilago farfara	2
kudzu	Pueraria montana var. lobata	2
perennial ryegrass	Lolium perenne	2
mile-a-minute vine, Asiatic tearthumb	Persicaria perfoliata	2
mimosa	Albizia julibrissin	2
Queen Anne's lace, wild carrot	Daucus carota	2
red morning-glory	Ipomoea coccinea	2
sweet vernalgrass	Anthoxanthum odoratum	2
sticky chickweed	Cerastium glomeratum	2
scarlet pimpernel	Anagallis arvensis	2
purple deadnettle	Lamium purpureum	2
round leaf bittersweet	Celastrus orbiculatus	2
sericea lespedeza	Lespedeza cuneata	2
sheep fescue	Festuca trachyphylla	1
shepherd's cress	Teesdalia nudicaulis	1
shepherd's-purse	Capsella bursa-pastoris	1
shrubby lespedeza	Lespedeza bicolor	1

Prevalent Invasive Species		
Common Name	**Scientific Name**	**Number of Records**
silver hairgrass	Aira caryophyllea	1
small carpetgrass, joint-head grass	Arthraxon hispidus	1
small hop clover	Trifolium dubium	1
smooth cordgrass	Spartina alterniflora	1
smutgrass	Sporobolus indicus	1
soft brome	Bromus hordeaceus	1
soft brome	Bromus hordeaceus ssp. hordeaceus	1
sour cherry	Prunus cerasus	1
rush skeletonweed	Chondrilla juncea	1
Russian olive	Elaeagnus angustifolia	1
Russian thistle	Salsola kali	1
rye brome	Bromus secalinus	1
sacred bamboo	Nandina domestica	1
saltmeadow cordgrass	Spartina patens	1
quackgrass	Elymus repens	1
red fescue	Festuca rubra	1
Scotch broom	Cytisus scoparius	1
Seaside rose	Rosa rugosa	1
sensitive partridgepea	Chamaecrista nictitans	1
spanishneedles	Bidens bipinnata	1
spearmint	Mentha spicata	1
spiny amaranth	Amaranthus spinosus	1
spiny sowthistle	Sonchus asper	1
stinging nettle	Urtica dioica	1
stinkgrass	Eragrostis cilianensis	1
sulfur cinquefoil	Potentilla recta	1
sweet autumn virginsbower	Clematis terniflora	1
spring whitlowgrass	Draba verna	1
star-of-Bethlehem	Ornithogalum umbellatum	1
starch grape hyacinth	Muscari neglectum	1
sweetbriar	Rosa rubiginosa	1
tall lettuce	Lactuca canadensis	1
tawny daylily	Hemerocallis fulva	1
Thunberg's meadowsweet	Spiraea thunbergii	1
thymeleaf sandwort	Arenaria serpyllifolia	1
thymeleaf speedwell	Veronica serpyllifolia	1
timothy	Phleum pratense	1
true forget-me-not	Myosotis scorpioides	1
velvetleaf	Abutilon theophrasti	1

Prevalent Invasive Species		
Common Name	**Scientific Name**	**Number of Records**
Virginia pepperweed	Lepidium virginicum	1
waterpurslane	Ludwigia palustris	1
wavyleaf basketgrass	Oplismenus undulatifolius	1
weeping lovegrass	Eragrostis curvula	1
weeping willow	Salix babylonica	1
white campion	Silene latifolia	1
white sweetclover	Melilotus albus	1
white willow	Salix alba	1
whorled pennywort	Hydrocotyle verticillata	1
wild celery	Apium graveolens	1
wild garlic	Allium vineale	1
spotted knapweed	Centaurea stoebe ssp. micranthos	1
white horehound	Marrubium vulgare	1
winged burning bush	Euonymus alatus	1
Wisconsin weeping willow	Salix x pendulina	1
yellow foxtail	Setaria pumila	1
yellow nutsedge	Cyperus esculentus	1
yellow rocket	Barbarea vulgaris	1
yellow sweet-clover	Melilotus officinalis	1
yellow toadflax	Linaria vulgaris	1
yellow woodsorrel	Oxalis stricta	1
red sorrel	Rumex acetosella	1
red-eared slider	Trachemys scripta elegans	1
redstem filaree	Erodium cicutarium	1
redtop	Agrostis gigantea	1
rice flatsedge	Cyperus iria	1
rose of Sharon	Hibiscus syriacus	1
roughstalk bluegrass	Poa trivialis	1
rabbitfoot clover	Trifolium arvense	1
radish	Raphanus sativus	1
rattail fescue	Vulpia myuros	1
mimosa webworm	Homadaula anisocentra	1
moth mullein	Verbascum blattaria	1
mouse-eared hawkweed	Pilosella officinarum	1
mugwort	Artemisia vulgaris	1
perilla mint	Perilla frutescens	1
piedmont bedstraw	Cruciata pedemontana	1
pitted morning-glory	Ipomoea lacunosa	1
poverty brome	Bromus sterilis	1

Prevalent Invasive Species		
Common Name	**Scientific Name**	**Number of Records**
prickly lettuce	Lactuca serriola	1
princesstree	Paulownia tomentosa	1
purple crown-vetch	Securigera varia	1
purple cudweed	Gamochaeta purpurea	1
orchardgrass	Dactylis glomerata	1
Oriental lady's thumb	Persicaria longiseta	1
oxeye daisy	Leucanthemum vulgare	1
pale smartweed	Polygonum lapathifolium	1
paper-mulberry	Broussonetia papyrifera	1
paradise apple	Malus pumila	1
peppermint	Mentha x piperita	1
kudzu bug	Megacopta cribraria	1
ladysthumb	Persicaria maculosa	1
lambsquarters	Chenopodium album	1
large crabgrass	Digitaria sanguinalis	1
large hop clover	Trifolium campestre	1
leatherleaf mahonia	Mahonia bealei	1
Lombardy poplar	Populus nigra	1
Long's sedge	Carex longii	1
longspine sandbur	Cenchrus longispinus	1
marsh dayflower	Murdannia keisak	1
meadow fescue	Festuca pratensis	1
memorial rose	Rosa lucieae	1
mexicantea	Dysphania ambrosioides	1
Japanese knotweed	Reynoutria japonica	1
Japanese wisteria	Wisteria floribunda	1
jimsonweed	Datura stramonium	1
johnsongrass	Sorghum halepense	1
Kentucky bluegrass	Poa pratensis	1
knotroot foxtail	Setaria parviflora	1
Korean lespedeza	Kummerowia stipulacea	1
hairy cat's ear	Hypochaeris radicata	1
hairy vetch	Vicia villosa	1
hedge bindweed	Calystegia sepium	1
hedge mustard	Sisymbrium officinale	1
green bristlegrass	Setaria viridis var. viridis	1
green foxtail	Setaria viridis	1
European privet	Ligustrum vulgare	1
everlasting peavine	Lathyrus latifolius	1

Prevalent Invasive Species		
Common Name	**Scientific Name**	**Number of Records**
highbush blackberry	Rubus argutus	1
hop clover	Trifolium aureum	1
imported willow leaf beetle	Plagiodera versicolora	1
ivyleaf morning-glory	Ipomoea hederacea	1
ivyleaf speedwell	Veronica hederifolia	1
Japanese beetle	Popillia japonica	1
Japanese clover	Kummerowia striata	1
bald brome	Bromus racemosus	1
barnyardgrass	Echinochloa crus-galli	1
bermudagrass	Cynodon dactylon	1
big chickweed	Cerastium fontanum ssp. vulgare	1
bird vetch	Vicia cracca	1
birdsfoot trefoil	Lotus corniculatus	1
birdsrape mustard	Brassica rapa	1
bittersweet nightshade	Solanum dulcamara	1
black locust	Robinia pseudoacacia	1
black medic	Medicago lupulina	1
bouncingbet	Saponaria officinalis	1
broadleaf plantain	Plantago major	1
broomsedge bluestem	Andropogon virginicus	1
American burnweed	Erechtites hieraciifolius	1
Amur honeysuckle	Lonicera maackii	1
annual bluegrass	Poa annua	1
annual honesty	Lunaria annua	1
arrow bamboo	Pseudosasa japonica	1
Canada bluegrass	Poa compressa	1
Canadian horseweed	Erigeron canadensis	1
cheatgrass, downy brome	Bromus tectorum	1
chestnut blight or canker	Cryphonectria parasitica	1
chicory	Cichorium intybus	1
bulbous buttercup	Ranunculus bulbosus	1
bull thistle	Cirsium vulgare	1
Asiatic hawksbeard	Youngia japonica	1
common chickweed	Stellaria pallida	1
common cocklebur	Xanthium strumarium	1
common duckweed	Lemna minor	1
common groundsel	Senecio vulgaris	1
common lilac	Syringa vulgaris	1
common mallow	Malva neglecta	1

Prevalent Invasive Species		
Common Name	**Scientific Name**	**Number of Records**
common mouse-ear chickweed	Cerastium fontanum	1
common selfheal	Prunella vulgaris	1
common St. Johnswort	Hypericum perforatum	1
common velvetgrass	Holcus lanatus	1
common vetch	Vicia sativa	1
common viper's bugloss, blueweed	Echium vulgare	1
common yarrow	Achillea millefolium	1
common purslane	Portulaca oleracea	1
common pear	Pyrus communis	1
common periwinkle	Vinca minor	1
corn gromwell	Buglossoides arvensis	1
corn speedwell	Veronica arvensis	1
creeping bentgrass	Agrostis stolonifera	1
curly dock	Rumex crispus	1
curly dock	Rumex crispus ssp. crispus	1
curly leaf pondweed	Potamogeton crispus	1
cutleaf evening-primrose	Oenothera laciniata	1
cutleaf geranium	Geranium dissectum	1
dallisgrass	Paspalum dilatatum	1
dandelion	Taraxacum officinale	1
denseflower knotweed	Persicaria glabra	1
Deptford pink	Dianthus armeria	1
dog rose	Rosa canina	1
eastern white pine	Pinus strobus	1
eclipta	Eclipta prostrata	1
dotted smartweed	Persicaria punctata	1
eastern poison-ivy	Toxicodendron radicans	1
Eurasian watermilfoil	Myriophyllum spicatum	1
European common reed, Phragmites	Phragmites australis ssp. australis	1
false green kyllinga	Cyperus brevifolioides	1
false strawberry	Potentilla indica	1
fennel	Foeniculum vulgare	1
field bindweed	Convolvulus arvensis	1
field brome	Bromus arvensis	1
field madder	Sherardia arvensis	1
French rose	Rosa gallica	1
garlic mustard	Alliaria petiolata	1
giant foxtail	Setaria faberi	1
goosegrass	Eleusine indica	1

Prevalent Invasive Species		
Common Name	**Scientific Name**	**Number of Records**
goutweed	Aegopodium podagraria	1
Source: EDD Maps, 2023 (for Calvert County, MD)		

4.3.8.4 Future Occurrence

The probability of future occurrence for invasive species threats is growing due to the increasing volume of transported goods, increasing efficiency and speed of transportation, and expanding international trade agreements. Expanded global trade has created opportunities for many organisms to be transported to and establish themselves in new counties and regions. According to Maryland government, Maryland imported products worth a total of $38.4 billion in 2021. These goods were imported from Germany, Mexico, Japan, Canada, and China. These locations have been known in the past to contribute pests to the United States. Climate change is contributing to the introduction of new invasive species. As maximum and minimum seasonal temperatures change, pests can establish themselves in previously inhospitable climates. This also gives introduced species an earlier start and increases the magnitude of their growth, possibly shifting the dominance of ecosystems in the favor of non-native species.

There are several invasive species that are found near Calvert County but have not yet been detected inside the county (see *Table 36 – Future Vulnerable Species*). Especially in cases like this, control efforts, heightened awareness, and public outreach and education can help prevent an invasive species from becoming established in the future. Once a species is established, it is more difficult to eradicate it from an ecosystem, so prevention is very important. The species that are labeled in red are listed as a Rank 1 species, which indicates a severe ecological threat to the environment. Therefore, invasive species are present and highly problematic in nearby counties but have not been reported in Calvert County (as shown highlighted in red in *Table 36 – Future Vulnerable Species*). The development of appropriate plans will assist the county in reducing the possibility of a future encounter with any of these species. Working toward keeping these species from entering the area would be beneficial to the forests and waterways of Calvert County.

Climate change and its relationship with invasive species has a major correlation. According to the U.S Geological Survey, climate change has been creating a new pathway for invasive species to be introduced into the environment. As an example, the rise in temperature allows existing invasive species to expand their geographic area. Also, climate change hinders the tools for eliminating invasive species.

Table 36 - Future Vulnerable Species

Future Vulnerable Species		
Scientific Name	**Common Name**	**Type**
Corbicula fluminea	Asiatic Clam	Animal
Scolytus schevyrewi	Banded Elm Bark Beetle	Insect
Brassica nigra	Black Mustard	Plant
Otiorhynchus sulcatus	Black Vine Weevil	Insect
Linaria dalmatica	Dalmatian Toadflax	Plant
Myriophyllum spicatum	Eurasian Watermilfoil	Plant
Trapa natans	European Water Chestnut	Plant
Convolvulus arvensis	Field Bindweed	Plant
Frangula alnus	Glossy Buckthorn	Plant
Galega officinalis	Goatsrue	Plant
Humulus japonicus	Japanese Hops	Plant
Pristiphora erichsonii	Larch Sawfly	Insect
Carduus nutans	Musk Thistle	Plant
Ligustrum spp.	Privet	Plant
Trachemys scripta elegans	Red-eared Slider	Amphibian
Cytisus scoparius L.	Scotch Broom	Plant
Bipalium pennsylvanicum Ogren	Three-Lined Land Planarian	Animal
Salix alba	White Willow	Plant
Source: EDDMaps, 2021; iMapInvasives, 2021		

4.3.8.5 Vulnerability Assessment

Calvert County's vulnerability to invasion depends on the species in question. Human activity and mobility are ever increasing, and combined with the prospects of climate change, invasive species are becoming increasingly threatening. Invasive species can have adverse economic effects by impacting agriculture and logging activities. Natural forest ecosystems provide clean water, recreational opportunities, habitat for native wildlife, and places to enjoy the tranquility and transcendence of nature. The balance of forest ecosystems and forest health are vulnerable to invasive species threats. While there is significant acreage of wetlands, waterways, state parks, and game lands in Calvert County where forest managers can impact invasive species, private lands can provide refuge for invasive species if landowners are unaware of or apathetic towards the threat.

Since there are large swatches of public land in Calvert County, there is a risk of future damage from invasive species that are present in the area. With about 136,320 square acres of total land area and 84,480 acres of total water area in Calvert County, there is vulnerability to various land sites and waterways. If an invasive species were to invade the popular terrestrial areas or waterways in Calvert County, a negative impact could occur. The invasion from an invasive species could cause damage to the scenic and natural resources needed in the county.

Additionally, tourism for the county is vulnerable to the invasive species as well and would be affected if the parks were destroyed. Therefore, a great amount of land and native wildlife within Calvert County are at risk with the presence of invasive species.

An interesting facet of the invasive species problem in Maryland is that deer do not eat many invasive plants, giving invasive species a competitive advantage over the native species that deer prefer. As such, the management of deer populations in Calvert County has a significant impact on the vulnerability of an ecosystem to invasive species, where overpopulation of deer favors invasive species.

Due to the past experiences with invasive plants in the county, there are five primary components which help with managing invasive plants to lower vulnerability:

Prioritize: Public use areas such as state parks and other healthy forest ecosystems should be prioritized over developed and private areas. Locations with lower densities of invasive plants are often easier to control and should be given quick attention. Locations where humans are disturbing the landscape opens up niche space, and often times the aggressive invasive species move in faster than native species. Such locations include areas around road work, ditch/culvert work, logging activities, stream improvement/stabilization and bridge work. Some species pose a higher risk than others - invasive species are easiest to control before they become widespread and established in an area, and for that reason, species that are less widespread should be prioritized for management.

Locate: Detailed locations should be recorded for invasive plants so sites can be easily relocated, treated, and monitored.

Delineate: The scale and extent of the infestation should be recorded and mapped so that the progress of the infestation can be monitored.

Control: Methods of control depend on the specific infestation, but the most common approaches are mechanical (cutting and hand-pulling) and chemical (herbicide treatments).

Monitor: Identified sites should be monitored and revisited as often as several times in a growing season (depending on the location/species). Monitoring can allow for early detection of spreading infestations. Most importantly, it prevents a relapse towards full-blown infestation.

It is best to act before a species can become established in the county, so forest management such as park rangers should be aware of invasive species found nearby Calvert County, but not yet present in the county (priority species in *Table 36 – Future Vulnerable Species*). Public outreach and education are important to increase knowledge of these species to improve identification and prevention of invasion. Without action, due to the instances and extent of the current infestations, it is reasonable to project that the county's vulnerability will increase.

All of the socially vulnerable populations in Calvert County are at an increased vulnerability to invasive species. The homeless and the unsheltered populations are at risk due to not having a structure to reside in. Also, the economically vulnerable of Calvert County may not have the capability to fix or hire pest control if their homes are damaged or overrun by invasive species.

As seen in *Table 2 – Population Change in Calvert County*, the Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. Based on this information, it can be speculated that these municipalities may have an increased risk to invasive species, since 2010, due to the increase in population and construction.

Land use changes in Calvert County could be a factor in the potential impact invasive species have on native species. Land use is a major factor with the severity of invasive species. Land use, in the form of a built environment, such as residential expansion, can cause invasive species impact severity to increase. Impact severity increases because as the built environment expands and becomes more complex, the impact the event will have on that area also increases because there is an influx of people, infrastructure, and critical infrastructure in the hazard area. According to Smithsonian Environmental Research Center, invasive species thrive on major land use disturbances, as an example the logging of a forest or flooding to a wetland can create conditions that invasive species thrive on to move into a specific area.

4.3.9. Landslides

4.3.9.1 Location and Extent

Rock falls and other slope failures can occur in areas of Calvert County with moderate to steep slopes. Many slope failures are associated with precipitation events – periods of sustained above-average precipitation, specific rainstorms, or snowmelt events. Rockfalls, rockslides, rock topples, block slides, debris flows, mud flows, and mud slides are all forms of landslides. Areas experiencing erosion, decline in vegetation cover and earthquakes are also susceptible to landslides. Human activities that contribute to slope failure include altering the natural slope gradient, increasing soil and water content, and removing vegetation cover. Areas where this type of human activity is common are areas that were excavated along highways and other roadways.

The landslide susceptibility in Calvert County is generally moderate, with a particular focus on landslides along the cliffs in Calvert County. *Figure 23 – Landslide Hazard Areas* shows areas of landslide susceptibility in Calvert County. All of Calvert County is located in the Coastal Plain physiographic province which is known for low vulnerability to all forms of landslide, but cliff erosion is a unique issue for Calvert County. Steep slopes are evenly spread throughout the county and there are locations that can be prone to landslides in almost every municipality.

Cliff erosion as it relates to landslides is increasingly becoming a more persistent issue in Calvert County. Cliff erosion has in the past exposed different types of infrastructure including septic tanks.

4.3.9.2 Range of Magnitude

Landslides cause damage to transportation routes, utilities, and buildings. They can also create travel delays and other side effects for transportation of people and material. Fortunately, death and injuries due to landslides are relatively rare in Maryland. Almost all of the known deaths due to landslides have occurred when rocks fall or other slide along highways involve vehicles. Storm-induced debris flows are the only other type of landslide likely to cause injuries. As residential and recreational development increase on and near steep mountain slopes, the hazard from these rapid events will also increase. Most Maryland landslides are moderate to slow moving and damage objects and buildings, rather than people.

The Maryland Department of Transportation (MDOT) and large municipalities incur substantial costs due to landslide damage and to additional construction costs for new roads in known landslide-prone areas. A 1991 estimate showed an average of $10 million per year is spent on landslide repair contracts across the State of Maryland and a similar amount is spent on mitigation costs for grading projects. A number of highway sites in Maryland need temporary or permanent repair at an estimated cost of between $300,000.00 and $2 million each. Similar landslide events that effect traffic and roadways throughout the state occur intermittently throughout the year.

The 2021 Maryland Hazard Mitigation Plan lists Calvert County as having a low vulnerability to soil movement, which includes landslide events. Calvert County landowners and real estate developers must know the magnitude of susceptibility within the county prior to the start of development.

4.3.9.3 Past Occurrence

There are only two recorded incidents in Calvert County available, and there is no formal reporting system in place. MDOT and municipal departments are responsible for slides that inhibit the flow of traffic or damage roads and bridges, but they generally only repair the road and the adjacent right-of-way areas.

Table 37 - Landslide Incidents in Calvert County

Landslide Incidents in Calvert County		
Location	**Date**	**Confidence**
Lusby (Chesapeake Ranch Estates)	10/01/2010	2
Chesapeake Beach	05/19/2018	2

Source: USGS
Note: Confidence rates are provided by USGS. A level two confidence rate is indicative of a possible landslide in the area.

4.3.9.4 Future Occurrence

Historically, significant landslide events are not likely to occur every year in Calvert County. Mismanaged development in steeply sloped areas could increase the frequency of occurrence. Road cuts are the most common development that puts an area at an increased probability of a slide. The Maryland Department of the Environment (MDE) has an Erosion and Sediment (E & S) program that sets requirements intended to mitigate erosion associated with development projects of a certain scale. The guidelines offered in this program are similar to landslides prevention practices.

Climate change has the potential to increase the frequency of landslides in Calvert County. Climate change could result in more intense rainfall from more frequent hurricanes and tropical storms. This increase in rainfall could cause an increase in soil runoff, therefore weakening slopes that are steep and considered to be a hazard. More frequent landslides could occur from this weakening of the slopes because soil movement will likely increase with a higher volume of precipitation.

4.3.9.5 Vulnerability Assessment

Landslides are often precipitated by other natural hazards such as earthquakes or floods. A significant landslide can cause millions of dollars in damages. Continued enforcement of floodplain management and proper road and building construction can mitigate the vulnerability to landslides. Floodplain management is important where mining has occurred within proximity to watercourses and associated flat-lying areas. Surface water may permeate into areas that still have open fractures and the build-up of surface water in those fractures could lead to unexpected flood events and landslide events.

Land use and development has the potential to increase the vulnerability of Calvert County to landslides. Development of major infrastructure and commercial or residential areas near areas of steep slope, or areas where slopes are over 23° could create conditions in the future where landslides are more likely to occur. Also, the development of roadways, and the grading of roadway berms could also increase the potential for landslides. This is common in steeply sloped areas or areas where roads are built below a slope or embankment. The removal of forested areas or trees could cause landslides along slopes and embankments. Trees and tree root systems create hill stability, and the removal of those root systems could result in weakened slopes. This practice can be remediated and fixed with protection netting and gabion baskets or gabion walls.

A comprehensive database of land highly prone to erosion and landslides is difficult to produce. The potential for erosion and landslides should be considered when planning construction projects in Calvert County. There are several general factors that can be indicators of landslide prone areas including:

- Locations on or close to steep hills.
- Areas of steep road cuts or excavations.
- Steep areas where surface run-off is channeled.
- Fan shaped areas of sediment and rock accumulations.
- Evidence of past sliding such as tilted utility line, tilted trees, cracks in the ground and irregularly, surfaced ground.

Lusby is the area in Calvert County that is most susceptible to landslides. *Table 38 – Structure Vulnerability Data* illustrates the number of site structure address points per municipality and the number of structures in high slope areas. Landslide events are most likely to occur in steeply sloped areas and in places where landforms have been altered for purposes of highway construction or other development. This is especially true if development is located at the base or crest of cliffs or near large highway cut-outs. These areas should be considered vulnerable to landslides, particularly if mitigation measures have not been implemented.

Table 38 - Structure Vulnerability Data

Structure Vulnerability Data		
Municipality/Town Center/CDP	**Number of Addressable Structures Per Area**	**Number of Structures in Slope Area**
Town of Chesapeake Beach	4,650	0
Town of North Beach	1,742	0
Broomes Island	258	0
Dunkirk	2,551	0
Huntingtown	5,855	0
Lusby	9,520	23
Owings	3,620	0
Port Republic	1,631	1
Prince Frederick	6,341	1
Solomons	2,010	0
St. Leonard	2,859	0
Sunderland	763	0
Totals:	**41,800**	**25**

Impact of landslides on historic properties in Calvert County

The following historic properties in Calvert County are at an increased risk to landslides because of their overlap with areas in the county where slopes are over 25°: Grahame House, La Veille, Morgan Hill Farm, Patterson Archaeological and Historic District, Taney Place, and Willow Glenn.

None of the locations potentially impacted by landslides are within an incorporated municipality for Calvert County.

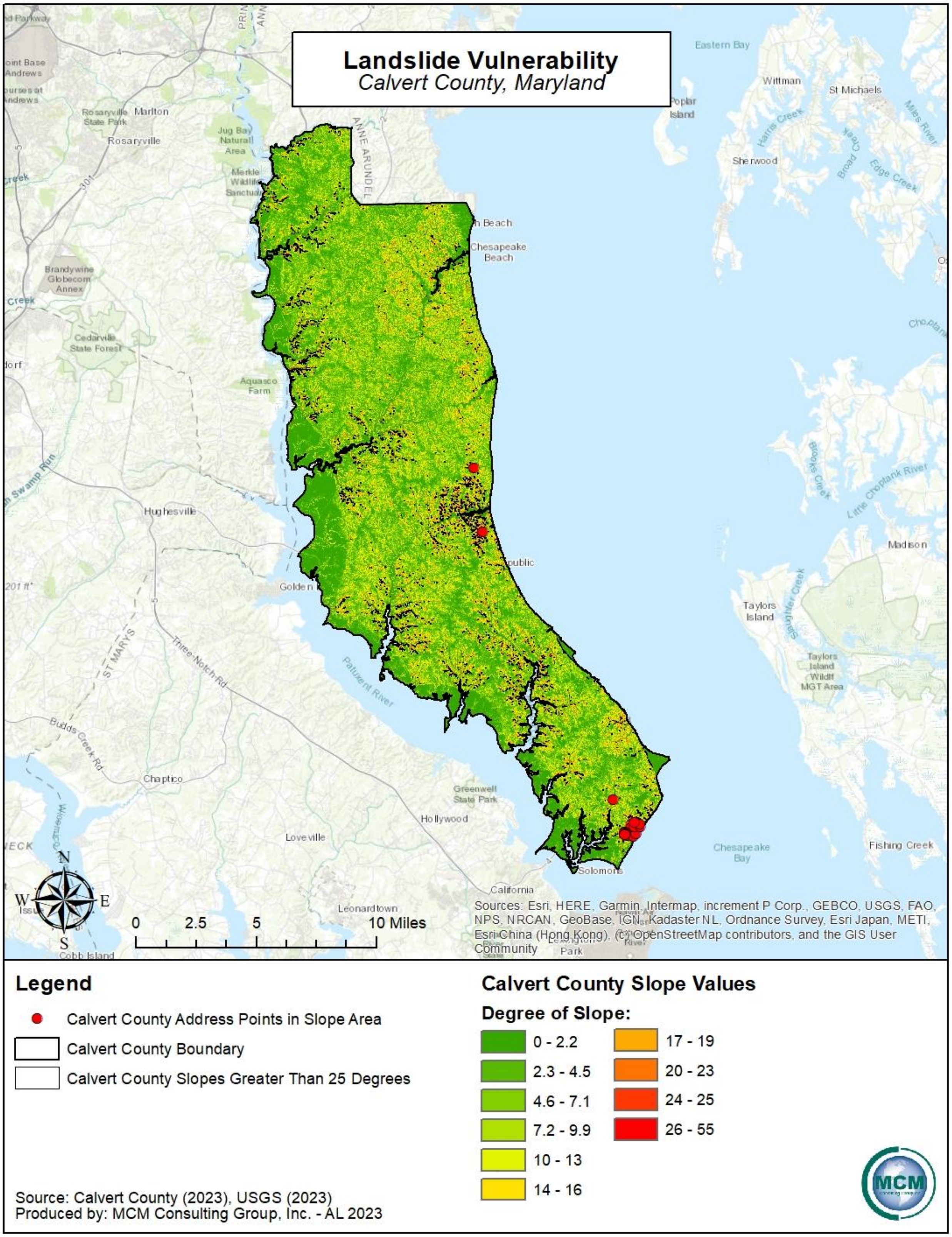
The socially vulnerable populations and communities in Calvert County, including the homeless and unsheltered populations, are at an increased vulnerability to landslides. Those socially vulnerable populations can be found in the higher population density areas of the county.

As seen in *Table 2 – Population Change in Calvert County*, the Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. Based on this information, it can be speculated that these municipalities may have an increased/equivalent risk to landslides, since 2010, due to the increase in population and construction.

When a landslide occurs, the resulting ground instability can lead to telephone pole collapse, disruption of fiber or copper cables systems, and in severe cases, cellular tower failure. The disruption to these networks, if the landslide event is significant, can also result in a loss of communication capabilities, hindering response coordination, and leaving communities impacted by the landslide vulnerable to other natural or human-caused hazards. Landslide events can also cause above ground localized transportation issues if an event were to occur along a transportation route through Calvert County. This can cause a delay in daily transportation and may require alternate transportation routes to be established for an extended period of time.

Natural areas and resources in Calvert County could be adversely impacted from landslides. Landslide typically occur in areas of steep slope, or areas of slope instability. Specific natural areas or parks that have the potential for landslides due to steep slopes includes the Calvert Cliffs State Park and the Flags Pond Nature Park. Landslides occur in natural areas on a regular basis and are often reported only after they are observed. Natural resources that are utilized by the residents and businesses of Calvert County could be damaged by landslides. This could include any farming, land cultivation, lumbering, or development of natural products.

Figure 23 - Landslide Hazard Areas



4.3.10. Pandemic, Epidemic, and Infectious Disease

4.3.10.1 Location and Extent

Epidemic

An epidemic occurs when an infectious disease spreads more quickly than expected by medical and healthcare authorities. It is characterized by widespread growth or extent that spreads quickly and incurs a greater rate of novel or endemic cases than baseline estimates would initially project. When an epidemic occurs, it typically impacts a larger area than a localized outbreak. Epidemics often include multiple countries, although not always spreading to different continents. In short, epidemics are regional.

Pandemic

A pandemic is a disease outbreak that spreads across countries or continents, which affects the population of a vast area. When a pandemic occurs, the event usually affects more people and takes more lives than an epidemic. Pandemics are described as an extensive epidemic. Generally, pandemic diseases cause sudden illness in all age groups on a global scale. Pandemics are continuous events in third-world countries but do not frequently affect the United States. A pandemic is measured and defined by the spreading of a disease rather than the fatalities with which it is associated. The characteristics of a pandemic outbreak include large and rapid scale spread, overload of healthcare systems, inadequate medical supplies, disruption of economy/society, and medical supply shortages. While a pandemic may be characterized as a type of epidemic, an epidemic is not a type of pandemic. Additionally, pandemics travel more efficiently than epidemics. In the event that a pandemic occurs in the eastern United States, the entirety of Calvert County would likely be impacted.

Endemic

An endemic is described as a disease that is present in a community at all times but occurs in a relatively low frequency and is not spreading at a rapid rate. An endemic can be a previous pandemic such as influenza, or coronavirus (COVID-19), or a more regionalized virus such as Ebola virus in Africa. An endemic can become a pandemic if the disease mutates into a more virulent strain.

Infectious Disease

Infectious diseases are illnesses caused by pathogenic organisms such bacteria, viruses, fungi, or parasites. Organisms become harmful and cause disease under certain conditions. The sources of infectious disease may originate from contaminated food or waterways, infected animals/livestock, or infection from biological vectors such as mosquitoes, etc. Infectious diseases include influenza, rabies, Middle East Respiratory Syndrome (MERS), West Nile virus, Lyme Disease, Zika virus, and Ebola virus.

Pandemic and infectious disease events cover a wide geographical area and can affect large populations, potentially including the entire population of the State of Maryland. The exact size and extent of an infected population is dependent upon how easily the illness is spread, the mode of transmission, and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in more populated and urban areas where there are large concentrations of people. The transmission rate of infectious disease will depend on the mode of transmission of a given illness. Pandemic events can also occur after other natural disasters, particularly floods, when there is the potential for bacteria to grow in, and contaminate, standing water.

4.3.10.2 Range and Magnitude

Public health emergencies typically occur on a regional basis. The magnitude of pandemic or infectious disease threat in the state will range significantly depending on the aggressiveness of the virus in question, factors within the community that are impacted (medical care access, population density, etc.), and the ease of transmission. For example, the West Nile virus produces clinically asymptomatic cases less than 80% of the time. Therefore, approximately 20% of the cases result in mild infection, also known as West Nile fever. However, there is a small percentage of cases that could result in severe neurological disease and even death.

Pandemic influenza has a higher transmission rate from person-to-person compared to the West Nile virus. Advances in medical technologies have greatly reduced the number of deaths caused by influenza over time. In the early 1900s, flu pandemics historically caused tens of millions of deaths, while the 2009 Novel H1N1, known as swine flu, caused fewer than 20,000 deaths world-wide. Many people infected with swine flu in 2009 recovered without needing medical treatment. Without recent medical inventions and technologies, modern influenza would be associated with higher morbidity rates. About 70% of those who were hospitalized during the 2009 H1N1 flu virus in the United States belonged to a high-risk group. However, with the COVID-19 pandemic, the transmission rates were much higher than any previous outbreaks related to other members of the coronavirus family such as SARS-CoV and MERS-CoV.

In the past 100 years, humanity did not face a microbial pandemic similar in scale to the COVID-19 pandemic. The worldwide transmission rate of COVID-19 from human to human rapidly advanced in 2020 and 2021. Of the six global outbreaks of viral infections, three were caused by coronaviruses (SARS, MERS, and COVID-19).

While there are limited secondary hazards related to public health emergencies, an outbreak can cause a variety of cascading hazards. Civil disorder due to supply shortages is the most common cascading hazard to result from pandemic, epidemic, or infectious disease. Additional potential effects could include: a shortage of medical supplies and personnel, hoarding of household paper and cleaning supplies, school and business disruption, government closings, government restrictions on travel, low attendance at places of employment, slowed productivity, and widespread economic instability.

The World Health Organization (WHO) developed an alert system to help inform the world about the seriousness of a pandemic. The alert system has six phases, with Phase 1 being the lowest risk and Phase 6 being the greatest risk of pandemic. The phases were developed in 1999, but then revised in 2005 and 2009 to provide a global framework and aid countries in pandemic preparedness and response planning. These phases of alert systems were used during the COVID-19 pandemic. These phases are listed below in *Table 39 - Pandemic Influenza Phases*.

Table 39 - Pandemic Influenza Phases

Pandemic Influenza Phases	
Phase	**Characteristics**
Phase 1	No animal influenza virus circulating among animals has been reported to cause infection in humans.
Phase 2	An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat.
Phase 3	An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks.
Phase 4	Human-to-human transmission (H2H) of an animal or human-animal influenza virus able to sustain community-level outbreaks has been verified.
Phase 5	The same identified virus has caused sustained community level outbreaks in two or more countries in one WHO region.
Phase 6	The pandemic phase is characterized by community level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is under way.
Post-Peak Period	Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels.
Possible New Wave	Level of pandemic influenza activity in most countries with adequate surveillance rising again.

Pandemic Influenza Phases	
Phase	**Characteristics**
Post-Pandemic Period	Levels of influenza activity have returned to the levels seen for seasonal influenza in most countries with adequate surveillance.
Source: WHO, 2009	

4.3.10.3 Past Occurrence

Pandemic & Epidemic

Several pandemic influenza outbreaks have occurred over the past 100 years that not only affected Calvert County but the United States as a whole. *Table 40 - Past Pandemic Events in the United States* illustrates the various past pandemic events that have occurred since the late 1800's. Prior to COVID-19, the worst recorded pandemic was the Spanish Flu, due to the amount of infection spread that was present in the world. The two most recent pandemics that have occurred in Calvert County and the United States are the swine flu/Novel H1N1 and COVID-19 pandemics, with COVID-19 being the most current and having the highest transmission rates.

Spanish Flu

An estimated 1/3 of the world's population was infected and had clinically apparent illnesses during the 1918 - 1919 influenza pandemic. Maryland experienced severe effects from the Spanish Flu. It claimed 500,000 lives in the United States, which included individuals in Calvert County. There is a lack of data which provides exact numbers of deaths that occurred in Calvert County from the Spanish Flu, however there were a total of 60,000 deaths in Maryland. Deaths occurring in Calvert County are included in this number. There were approximately 75,000 reported cases and 4,125 deaths in Baltimore in just over four weeks. Baltimore was hit hard during the second wave of infections from the Spanish Flu. The factors of high population density including crowded and unhygienic conditions contributed to higher numbers of cases and death rates across Maryland.

Swine Flu/Avian Flu/H1N1

Each year, different strains of influenza are labeled as potential pandemic threats. Strains of influenza, or the flu, are highly contagious as they commonly attack the respiratory tract in humans. Influenza pandemic planning began in response to the H5N1 (avian) flu outbreak in Asia, Africa, Europe, the Pacific, and the Near East in the late 1990s and early 2000s. Avian flu did not reach pandemic proportions in the United States, but the country began planning for flu outbreaks.

Calvert County was impacted by the H1N1 virus during 2009. The Maryland Department of Health (MD DOH) set up clinics throughout the county to administer vaccines to at-risk populations. A total of 10,940 cases and seventy-eight deaths occurred in Maryland from this pandemic but there is insufficient data to determine the exact number of cases and deaths from swine flu in Calvert County.

COVID-19

Calvert County was directly impacted by the COVID-19 pandemic. As of June 2023, Maryland had an estimated 1,377,353 total cases and 16,435 deaths related to the COVID-19 pandemic. The first cases in Maryland were reported on March 5, 2020, in Montgomery County. The first confirmed case of COVID-19 in Calvert County was in March 2020. Beginning in December of 2020, there was a large-scale vaccination effort to combat COVID-19. Municipalities in Calvert County indicated a decrease in the pandemic and infectious disease section of the risk factor assessment municipal comparison.

Table 40 - Past Pandemic Events in the United States

Past Pandemic Events in the United States	
Year(s)	**Common Name**
1889	Russian Flu
1918	Spanish Flu/H1N1
1957	Asian Flu/H2N2
1968	Hong Kong Flu/H3N2
2009	Swine flu/Novel H1NI
2020	COVID-19
Sources: WHO & CDC, 2020	

Infectious Disease

Not only has Calvert County experienced pandemic events, but the county has also experienced infectious disease events. The two major infectious disease events experienced across Calvert County and Maryland as a whole are the West Nile Virus and Lyme Disease. Due to the climatic traits of Maryland these infectious diseases thrive in Calvert County. Both diseases are transmitted by the biological vector of an insect which is found throughout the county.

West Nile Virus

West Nile virus reached the United States in 1999 and was detected in Maryland when mosquito pools, dead birds, and/or horses tested positive for the virus. A comprehensive network has been developed in Maryland that includes trapping mosquitoes, collecting dead birds, and monitoring horses, people and, in past years, sentinel chickens. Although West Nile Virus positive cases are few in Calvert County, 2021 had the most positive cases since 2015. Over the past eight years, 114 humans have tested positive for West Nile Virus in Calvert County. *Table 41 - West Nile*

Virus Control Program in Calvert County since 2015 outlines the West Nile Virus within Calvert County from 2015 to 2022.

Table 41 - West Nile Virus Control Program in Calvert County since 2015

West Nile Virus Control Program in Calvert County Since 2015				
Year	**Total Positives**	**Human Positives**	**Mosquito Positives**	**Bird Positives**
2015	83	46	33	4
2016	13	6	6	1
2017	18	5	13	0
2018	77	45	32	0
2019	13	7	6	0
2020	5	1	3	1
2021	147	2	145	0
2022	31	2	29	0
Source: MD Department of Health, 2023				

Lyme Disease

Lyme Disease has been present in the United States and Calvert County for many years. More wooded areas have higher cases due to ticks being the main biological vector. Lyme disease is found in all twenty-three counties within Maryland. Calvert County has an overall approximate of 666 confirmed cases of Lyme disease from 2000 until 2020, although actual totals may be significantly higher due to under reporting. Calvert County as a whole has a moderately high positive total for Lyme Disease in the county, especially over the past several years. It is possible that numbers have risen dramatically due to lack of testing in previous years. Calvert County experienced the highest number of positive cases in 2015 and 2018. Lyme disease case counts have been consistently rising over the past several years. It should be noted that information represented for each county may vary due to reporting practices. Hence these figures represent a rough estimate of the Lyme disease burden in Calvert County. *Table 42 - Lyme Disease Data for Calvert County* outlines the total positive cases of Lyme Disease within Calvert County from 2008 to 2019. Data after 2019 was not available for this report.

Table 42 - Lyme Disease Data for Calvert County

Lyme Disease Data for Calvert County	
Year	**Total Positives**
2008	34
2009	40
2010	24
2011	24
2012	45

Lyme Disease Data for Calvert County	
Year	**Total Positives**
2013	63
2014	48
2015	90
2016	66
2017	76
2018	103
2019	53
Source: MD Department of Health, 2023	

Alpha-gal Syndrome

Alpha-gal syndrome is a potentially life-threatening allergic condition that is associated with a tick bite. More research is needed, but it is currently primarily associated with the bite of a lone star tick in the United States. Alpha-gal is a sugar molecule that can be found in meat (pork, beef, rabbit, lamb, venison, etc.), and when ingested by individuals with Alpha-gal syndrome reaction can occur. Reactions can include; hives or itchy rash, nausea or vomiting, heartburn or indigestion, diarrhea, cough, shortness of breath, or difficulty breathing, drop in blood pressure, swelling of the lips, throat, tongue, or eye lids, dizziness or faintness, or severe stomach pain. Symptoms will vary from person to person, as well as severity, ranging from mild all the way to life-threatening, known as anaphylaxis. A CDC report showed that more than 110,000 suspected cases of AGS were identified between 2010 and 2022.

Zika Virus

The Zika virus is another infectious disease that is spread by mosquito bites, and it is related to West Nile virus. Zika virus can also be spread through sexual intercourse, blood transfusion, or passed from mother to child in the womb. The virus was first identified in 1947, but largely came to the attention of the United States in 2015 when there was an outbreak of Zika in Brazil. The direct illness caused by Zika can include fever, red eyes, joint pain, headache, and a rash, or sometimes no symptoms at all. Zika is problematic for pregnant mothers as the virus can result in microcephaly or cause other problems for brain development. For adults, the virus can be linked to increased incidence of Guillain-Barré syndrome.

4.3.10.4 Future Occurrence

Pandemic & Epidemic

The probability of a widespread public health emergency affecting Calvert County is approximately once every ten years. Minor outbreaks of less serious communicable disease, such as influenza, will occur much more frequently. The occurrence of pandemic influenza outbreaks is unpredictable, and complete avoidance of the events is unlikely. Therefore, future occurrences of pandemics and infectious disease events are very likely. Pandemics may also emerge from other diseases, especially invasive pathogens for which Calvert County and Maryland as a whole lack natural immunity.

<u>Influenza</u>

It is estimated that 5% to 25% of Maryland get the flu each year, and 120 to 2,000 individuals die from complications of influenza. The CDC recommends that everyone six months and older get a flu vaccine every season to prevent future cases from rising. People who are at a high risk of serious flu illness should take flu antiviral drugs as soon as they get sick.

Infectious Disease

Infectious diseases such as West Nile Virus and Lyme Disease have been present in Calvert County for many years and are expected to perpetuate. The best way to prevent infectious disease outbreaks, including West Nile Virus and Lyme Disease, is to actively address the causes of the diseases. West Nile Virus occurrence can be reduced by removing mosquito breeding locations in stagnant water sources and Lyme Disease occurrence can be reduced by utilizing insect repellant, removing ticks promptly, applying pesticides, and reducing tick habitats. Occurrence of Zika Virus can also be reduced by removing mosquito breeding areas and areas of stagnant water. Both West Nile Virus and Lyme Disease are expected to continue occurring in Calvert County in the future.

Climate change can result in a wider range of pandemic, epidemics, and infectious diseases that can impact larger areas of the globe. As climate change continues to occur, more populations have the potential to come into contact with vectors for diseases. The migration of animals could also increase vulnerability to this hazard for populations in Calvert County. Climate change is discussed below in Section 4.3.10.5.

4.3.10.5 Vulnerability Assessment

Calvert County is considered to be a moderate vulnerability county in regard to the pandemic events. It is extremely difficult to predict the occurrence and the magnitude of a pandemic or epidemic event. The COVID-19 pandemic disproportionately affected populations over the age of sixty-five, especially those in nursing homes. It has had disparate effect on socially vulnerable populations, including unsheltered and homeless individuals.

Elderly individuals, children and immune deficient individuals are the most vulnerable to disease. Nursing facilities, personal care facilities, daycares, schools, and hospitals are considered more vulnerable since there are often groups of these socially vulnerable individuals present at these community lifelines. Congregate living facilities, including correctional institutions and dormitories would also be at an increased risk due to the difficulties in adhering to the social distancing required to help stop the spread of a pandemic. During the COVID-19 pandemic, nursing homes and personal care homes in Maryland reported high numbers of cases and deaths, and several county jails and state correctional institutions reported wide community spread.

Health-care workers and those working in direct-care (such as correctional institutions or those who cannot social distance due to their jobs) are more likely to be exposed to a pandemic disease. Those who work outdoors for extended periods of time in warm months may be more vulnerable to West Nile Virus, Lyme Disease, or the Zika virus.

The number of hospitals within the county, and availability of beds within the hospitals, determine the amount of care vulnerable and sick patients will receive. It is important for hospitals to review and exercise emergency response plans and continuity of operations plans (COOP) to ensure that there is an effective public health response.

Response to health events are coordinated with county emergency managers by the Maryland Department of Health.

Land use and land development could directly impact the vulnerability of Calvert County to pandemic, epidemic, and infectious disease. Development of forested and rural areas in the county could result in populations coming into direct contact with vectors for infectious disease including, most prominently, Lyme Disease and West Nile Virus. When areas that are rural and natural habitats for wildlife are developed, those vectors that live along and with wildlife have the potential to come into contact with the individuals developing the properties and the populations that will occupy or live in those areas. An increase in development could also lead to an increase in the number of individuals living in Calvert County, increasing the county's vulnerability to pandemic events, like COVID-19.

Climate change can significantly impact the dynamics of pandemics, epidemics, and infectious diseases. Rising temperatures and altered precipitation patterns can expand the geographic range of disease vectors, such as mosquitoes carrying diseases like malaria and dengue fever. Changes in climate can also affect the behavior and distribution of animal hosts, potentially facilitating the transmission of zoonotic diseases to humans. Extreme weather events, intensified by climate change, can also disrupt healthcare systems and infrastructure, hindering the response to outbreaks. Additionally, shifts in temperature and humidity can influence the survival and spread of pathogens, potentially leading to the emergence of new infectious diseases. Overall, climate change exacerbates the complexity and challenges of managing and preventing pandemics and epidemics, making it crucial to address both environmental and public health concerns in a coordinated manner to mitigate the impact on global health.

Population changes can directly impact the vulnerability of Calvert County to pandemic events, like COVID-19. With increased populations there is a greater risk of the spread of communicable diseases, especially in areas where the population density is high. The two incorporated municipalities in Calvert County have seen an increase in population between 2010 and 2020. This information is shown in *Table 2 – Population Change in Calvert County*. Calvert County should monitor population growth in the Town Centers as well. The socially vulnerable populations in Calvert County are at a higher vulnerability of pandemic, epidemic, and infectious diseases than lesser vulnerable populations. This is due to lack of health care services for homeless, unsheltered, and transient populations in Calvert County and the difficulty in receiving treatment for health issues stemming from pandemics, epidemics, and infectious diseases. The national social vulnerability index for Calvert County from CDC/ATSDR (Center for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry) is 0.0086 percent which represents a low level of vulnerability.

4.3.11. Radon Exposure

4.3.11.1 Location and Extent

Airborne radon gas is radioactive and is a step in the radioactive decay of uranium to radium. Radon is a noble gas, cannot be seen and has no odor. Like other noble gasses, radon gas is very stable, so it does not easily combine with other chemicals. Two isotopes of radon are commonly found: 222Rn and 220Rn. The 220Rn isotope has a very short half-life, so it often only exists for fifty-five seconds, not long enough to pose a hazard to humans. The 222Rn isotope has a half-life of 3.8 days which is long enough to pose a threat to humans. Still, due to the relatively short half-life of 222Rn, it only exists in relative proximity to its radioactive parent, usually within tens of feet away. Radon is a carcinogen and when inhaled, it can lead to the development of lung cancer.

Radioactivity, caused by airborne radon, has been recognized for many years as an important component in the natural background radioactivity exposure of humans, but it was not until the 1980s that the wide geographic distribution of elevated values in houses and the possibility of extremely high radon values in houses were recognized. The Environmental Protection Agency (EPA) guidelines state that mitigation actions should be taken if levels exceed 4pCi/L in a home.

Radon gas is considered ubiquitous and can be found in indoor and outdoor environments. There is no known safe level of exposure to radon. For most people in Maryland, the greatest risk of radon exposure is from within their home in rooms that are below, directly in contact with, or immediately above the ground. Sources of radon include radon in the air from soil and rock beneath homes, radon dissolved in water from private wells and exsolved during water use (rare in Maryland), and radon emanating from uranium-rich building materials such as concrete blocks or gypsum wallboard (also rare in Maryland). Key factors in radon concentration in homes are the rates of air flow into and out of the house, the location of air inflow, and the radon content of air in the surrounding soil. Because of the flow dynamics of air inside of most houses, even a small rate of soil radon gas inflow can lead to elevated radon concentrations.

There are several factors that contribute to higher radon levels in soil gas:

- Proximity to elevated uranium rich deposits (>50ppm). Areas within a few hundred feet of such deposits are most at risk. Such deposits are rare in Maryland.
- Some more common rocks have higher than average uranium content (5 to 50 ppm), and proximity to such rocks also increases the risk of radon exposure. These rock types include black shales as well as granitic and felsic alkali igneous rocks. This is the most common source of high radon levels in Maryland.
- Other soil and bedrock properties that facilitate radon mobility include the amount of pore space in the soil and its permeability – more porous soils will allow radon to travel more easily. Limestone-dolomite soils can also be predisposed to collect radon from radium resultant from weathering of iron oxide or clay surfaces. In some cases even with

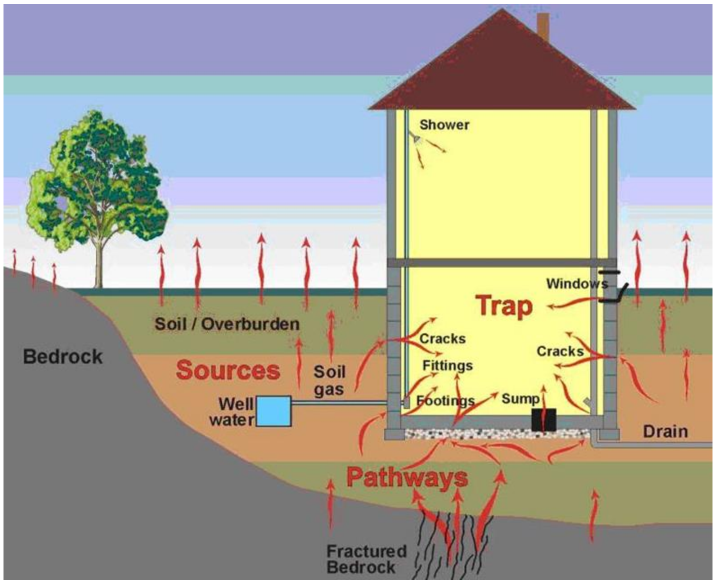
underlying bedrock having normal uranium concentrations (.5 to 5 ppm), the vast majority of locations built on limestone-dolomite soils exceed radon concentrations of 4pCi/L, and many exceeded 20 pCi/L.

The following three sources of radon in houses are now recognized (see *Figure 24 - Sketch of Radon Entry Points into a House* below):

- Radon in soil air that flows into the house
- Radon dissolved in water from private wells and exsolved during water usage; this is rarely a problem in Maryland
- Radon emanating from uranium-rich building materials (e.g., concrete blocks or gypsum wallboard); this is not known to be a problem in Maryland

High radon levels were initially thought to be exacerbated in houses that are tightly sealed, but it is now recognized that rates of airflow into and out of houses, plus the location of air inflow and the radon content of air in the surrounding soil, are key factors in radon concentrations. Outflows of air from a house, caused by a furnace, fan, thermal "chimney" effect, or wind effects, require that air be drawn into the house to compensate. If the upper part of the house is tight enough to impede influx of outdoor air (where radon concentration is generally <0.1 pCi/L), then an appreciable fraction of the air may be drawn in from the soil or fractured bedrock through the foundation and slab beneath the house, or through cracks and openings for pipes, sumps, and similar features. Soil gas typically contains from a few hundred to a few thousand pCi/L of radon; therefore, even a small rate of soil gas inflow can lead to elevated radon concentrations in a house.

Figure 24 - Sketch of Radon Entry Points into a House



The radon concentration of soil gas depends upon a number of soil properties, the importance of which is still being evaluated. In general, 10% to 50% of newly formed radon atoms escape the host mineral of their parent radium and gain access to the air-filled pore space. The radon content of soil gas clearly tends to be higher in soils containing higher levels of radium and uranium, especially if the radium occupies a site on or near the surface of a grain from which the radon can easily escape. The amount of pore space in the soil and its permeability for airflow, including cracks and channels, are important factors determining radon concentration in soil gas and its rate of flow into a house. Soil depth and moisture content, mineral host and form for radium, and other soil properties may also be important. For houses built on bedrock, fractured zones may supply air having radon concentrations similar to those in deep soil.

The second factor listed above is most likely the cause of high radon levels in Calvert County. The data show that most reported zip codes in the county have high basement radon level test results. The areas and test results are shown in more detail in the past occurrence section.

4.3.11.2 Range of Magnitude

According to the EPA, about 21,000 lung cancer deaths each year in the U.S. are related to radon. It is the second leading cause of lung cancer after smoking and the number one cause of lung cancer among nonsmokers. Radon causes lung cancer by continuing to radioactively decay after being inhaled, and turning into a daughter product (218Po, 214Pb, 214Bi) which may become attached to lung tissue and induce lung cancer due to the continued radioactive decay.

The EPA reports that the national average radon concentration of indoor air of homes is about 1.3 pCi/L, and they recommend that homes be fixed if the radon level is 4pCi/L or more. There is however no safe level of radon exposure, so the EPA also recommends considering fixing a home if the radon level is between 2 pCi/L and 4 pCi/L.

Table 43 - Radon Risk for Smokers and Nonsmokers shows the relationship between various radon levels, probability of lung cancer, comparable risks from other hazards, and action thresholds. As seen in *Table 43 - Radon Risk for Smokers and Nonsmokers* below, a smoker exposed to radon has a much higher risk of lung cancer.

Table 43 - Radon Risk for Smokers and Nonsmokers

Radon Risk for Smokers and Nonsmokers			
Radon Level (pCi/L)	**If 1,000 People Were Exposed to this level over a lifetime…***	**Risk of cancer from radon exposure compares to...*****	**Action Threshold**
SMOKERS			
20	About 260 people could get lung cancer	250 times the risk of drowning	Fix Structure
10	About 150 people could get lung cancer	200 times the risk of dying in a home fire	
8	About 120 people could get lung cancer	30 times the risk of dying in a fall	
4	About 62 people could get lung cancer	5 times the risk of dying in a car crash	
2	About 32 people could get lung cancer	6 times the risk of dying from poison	Consider fixing structure between 2 and 4 pCi/L
1.3	About 20 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2pCi/L is difficult
0.4	About 3 people could get lung cancer	(Average outdoor radon level)	
NON-SMOKERS			
20	About 36 people could get lung cancer	35 times the risk of drowning	Fix Structure
10	About 18 people could get lung cancer	20 times the risk of dying in a home fire	
8	About 15 people could get lung cancer	4 times the risk of dying in a fall	
4	About 7 people could get lung cancer	The risk of dying in a car crash	
2	About 4 people could get lung cancer	The risk of dying from poison	Consider fixing structure between 2 and 4 pCi/L
1.3	About 2 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2pCi/L is difficult
0.4	-	(Average outdoor radon level)	
Note: Risk may be lower for former smokers * Lifetime risk of lung cancer deaths from EPA Assessment of Risks from Radon in Homes (EPA 402-R-03-003). ** Comparison data calculated using the Centers for Disease Control and Prevention's 1999-2001 National Center for Injury Prevention and Control Reports.			

4.3.11.3 Past Occurrence

The Maryland Department of Health (MDH) provides information for homeowners about how to test for radon in their homes, and when they receive a test result over 4 pCi/L. The MDH has estimated that the national average indoor radon concentration is 1.3 pCi/L and the level for action is 4.0 pCi/L; however, they have estimated that the average indoor concentration in Maryland basements is about 7.1 pCi/L and 3.6 pCi/L on the first floor. The MDH records all the tests they receive and categorize them in a searchable database by zip code.

Figure 44 – Radon Test Results in Calvert County shows a total of fourteen zip codes in Calvert County where tests were reported to the Maryland Department of Health to report their findings; those with no available data were not included in the table. The highest average radon level was reported from the 20758 zip code, which is in the Friendship postal community of the county, with an average reading of 12.58 pCi/L within location of the basement.

Table 44 - Radon Test Results in Calvert County

Zip Code	Postal Community	Max Result pCi/L	Average Result pCi/L
20615	Broomes Island	3.20	3.20
20629	Dowell	N/a	N/a
20639	Huntington	45.70	5.64
20657	Lusby	12.90	3.05
20676	Port Republic	17.40	3.84
20678	Prince Frederick	18.48	3.81
20685	Saint Leonard	15.30	3.91
20688	Solomons	6.00	2.02
20689	Sunderland	44.60	11.04
20714	North Beach	18.20	2.82
20732	Chesapeake Beach	39.80	7.20
20736	Owings	63.40	6.93

Zip Code	Postal Community	Max Result pCi/L	Average Result pCi/L
20754	Dunkirk	37.50	7.80
20758	Friendship	30.50	12.58

4.3.11.4 Future Occurrence

Radon exposure is likely given the geologic and geomorphic conditions in Calvert County. The EPA and USGS have mapped radon potential in the US to help target resources and assist local governments in determining if radon-resistant features are applicable for new construction. Calvert County is located within an area with counties of high potential for radon which indicate an intermediate likelihood of occurrence in the future.

1. Zone 1 has the highest potential and readings can be expected to exceed the 4 pCi/L recommended limit.
2. Zone 2 has a moderate potential for radon with levels expected to be between 2 and 4 pCi/L and
3. Zone 3 has a low potential with levels expected to be less than 2 pCi/L.

Due to the moderate likelihood of future occurrence, the level of radon daughters should be monitored. Radon daughters are the concentration of decay products of radon in the uranium chain. Fortunately, the presence of radon daughters can be monitored through the means as radon gas. *Table 45 - Suggested Actions and Time Frame for Exposure to Radon Daughters* provides suggested actions and time frames for varying levels of exposure to radon daughters.

Table 45 - Suggested Actions and Time Frame for Exposure to Radon Daughters

Suggested Actions and Timeframe for Exposure to Radon Daughters		
Exposure Level*	Suggested Action**	Timeframe For Plan
more than 5.0 WL***	Residents should either promptly relocate or undertake temporary remedial action to lower levels as far below 5.0 WL as possible. Smoking in high areas discouraged.	Within 2-3 days
1.0 to 5.0 WL	Residents should undertake temporary remedial action to lower levels as far below 1.0 WL as possible. Smoking in high areas discouraged.	Within 1 week
0.5 to 1.0 WL	Residents should undertake temporary remedial action to lower levels as far below 0.5 WL as possible.	Within 2 weeks

Suggested Actions and Timeframe for Exposure to Radon Daughters		
Exposure Level*	Suggested Action**	Timeframe For Plan
0.1 to 0.5 WL	Residents should undertake temporary remedial action to lower levels as far below 0.1 WL as possible. Higher exposure levels require action to be taken in a shorter	3 weeks to 3 months
0.02 to 0.1 WL	Residents should undertake temporary and/or permanent remedial action to lower levels below 0.02 WL. Higher exposure levels require action to be taken in a shorter	4 to 15 months

4.3.11.5 Vulnerability Assessment

Proper testing for radon levels should be conducted across Calvert County, especially in the areas of higher incidence levels, and for those individuals and households that face the contributing risks. This testing will determine the level of vulnerability that residents face in their homes, as well as in their businesses and schools.

Calvert County is in the EPA Radon Hazard Zone One, meaning there is a high risk of radon exposure. Smokers can be up to ten times more vulnerable to lung cancer from high levels of radon depending on the level of radon they are exposed to. Additionally, older homes that have crawl spaces or unfinished basements are more vulnerable to having high radon levels. Average basement radon levels for homes who reported their results to the Maryland Department of Health are often found to be above the EPA action level of 4 pCi/L. *Figure 25 – Maryland Radon Levels* shows what areas in Maryland are at a higher risk for radon exposure. *Figure 26 – Radon Levels by Zip Code* shows the best available data from the EPA about the percentage of homes with radon levels at or above the EPA action level. The EPA estimates that an average radon mitigation system costs approximately $1,200.00.

Impact of radon on historic properties in Calvert County

Two properties are at an increased risk for radon exposure to individuals located there if the risk of radon in the following buildings have not been mitigated: All Saints’ Church and Joseph Lyons House.

These located are in an area of Calvert County that has an average radon reading of 11.04 pCi/L.

Figure 25 - Maryland Radon Levels

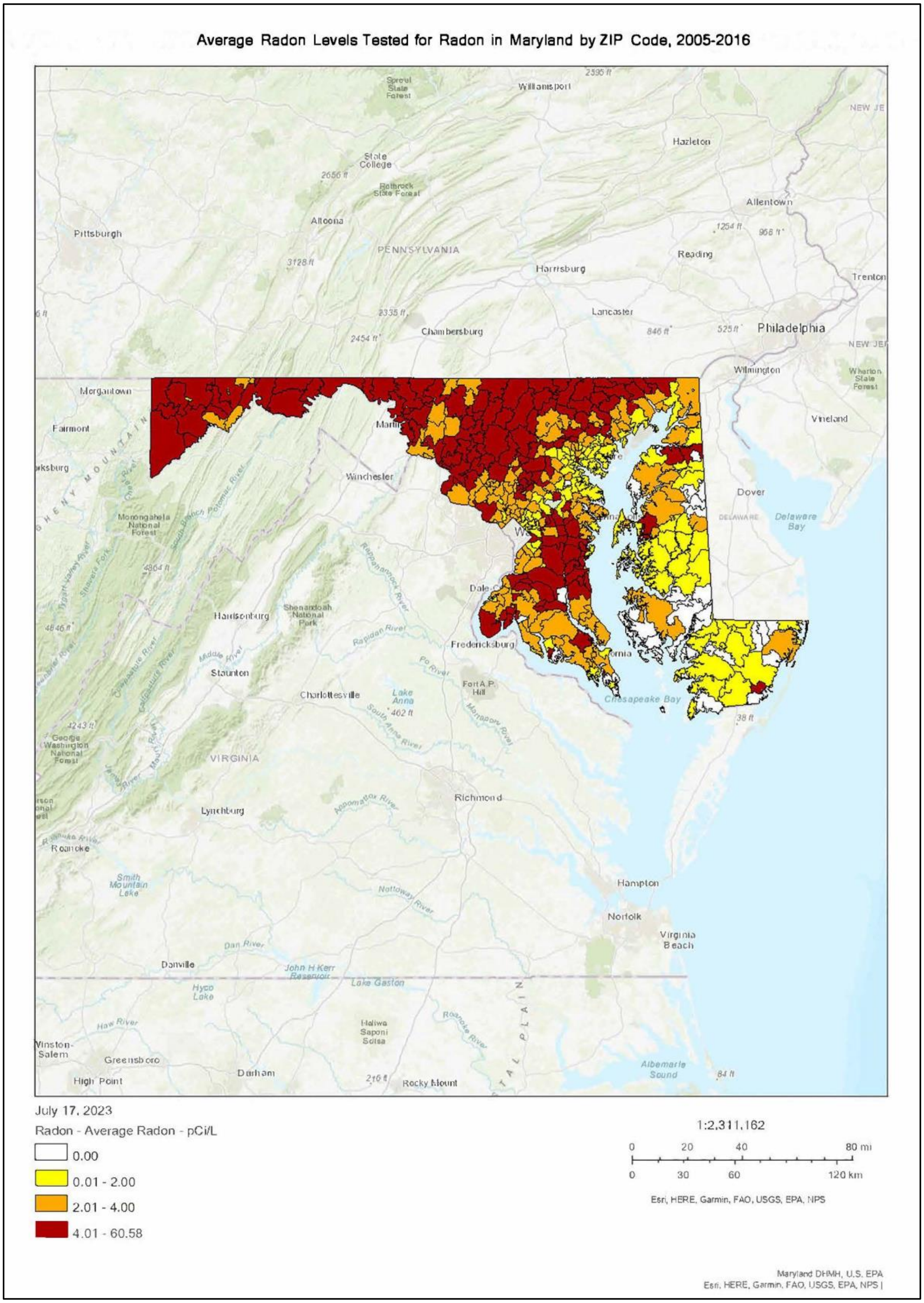
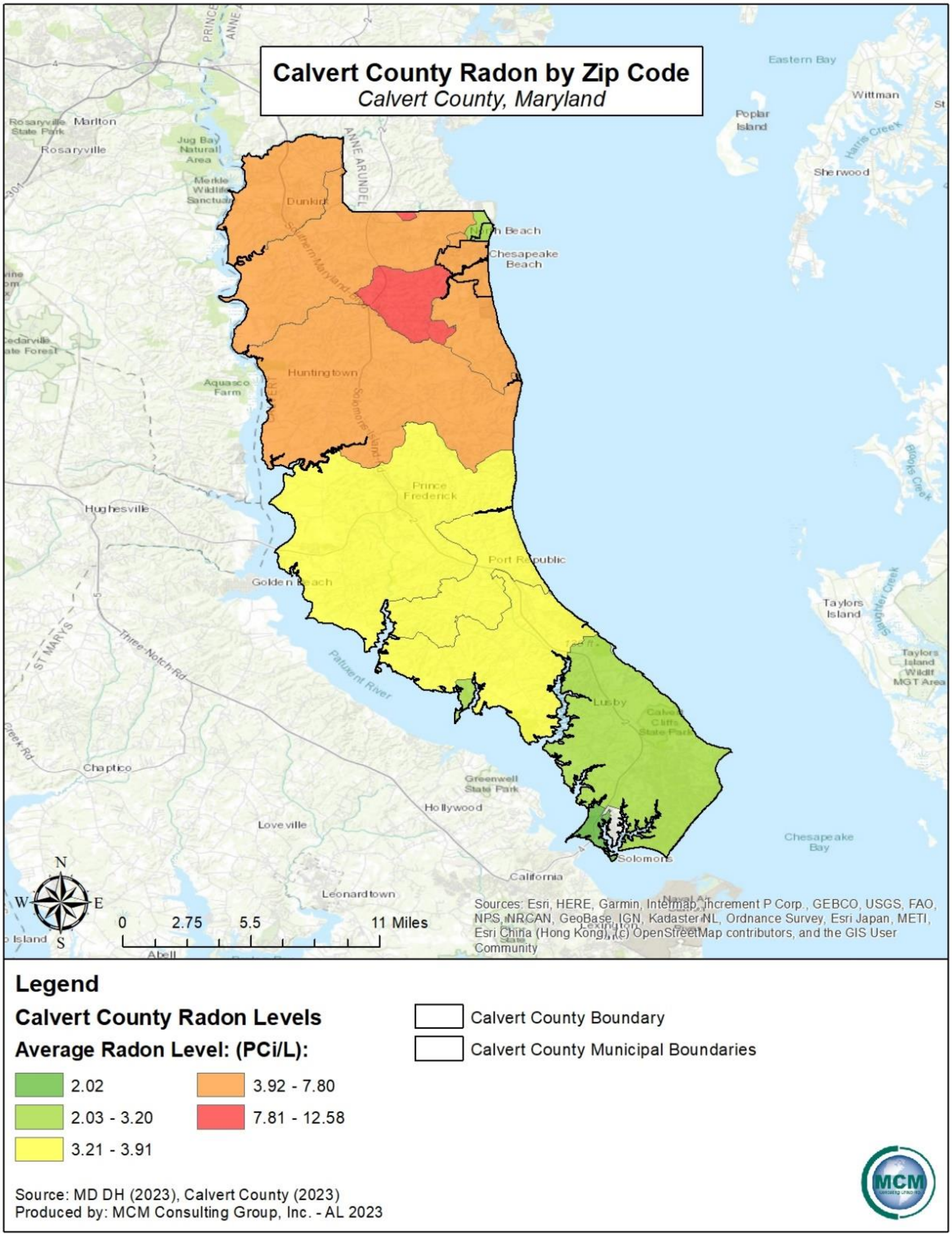


Figure 26 - Radon Levels by Zip Code



4.3.12. Subsidence and Sinkhole

4.3.12.1 Location and Extent

Subsidence is the sinking movement of the earth's surface; the result of this movement is commonly referred to as a sinkhole. There are two common causes of subsidence in Maryland: 1) dissolution of carbonate rock such as limestone or dolomite and 2) mining activity. In the first case, water passing through naturally occurring fractures and bedding planes dissolves bedrock leaving voids below the surface. Eventually, overburden on top of those voids collapses, leaving surface depressions resulting in what is known as karst topography. Characteristic structures associated with karst topography include sinkholes, linear depressions, and cases. Often, sub-surface solution of limestone will not result in the immediate formation of karst features. Collapse sometimes occur only after a large amount of activity, or when a heavy burden is placed on overlying material. Bedrock geology is found mostly in the south-central and eastern portions of the State of Maryland, and Calvert County is located in a karst vulnerable area. Subsidence in Calvert County is primarily due to karst topography and also as a result of mining activity. This plan will focus on both carbonate rock / karst topography and mining activity. Calvert County has a history of subsidence due to carbonate rock and mining activity.

Mining activity is concentrated in the southwestern region of the state. The majority of sub-surface (i.e., underground) extraction of materials such as oil, gas, coal, metal ores (i.e., copper, iron, and zinc), clay, shale, limestone, or water can result in slow-moving or abrupt shifts in the ground surface and these areas have a higher potential to be impacted by sinkholes and subsidence. Sinkholes often develop where the cover above a mine is thin. Sinkhole development normally occurs where the interval to the ground surface is less than three to five times the thickness of the extracted seam and the maximum interval is up to ten times the thickness of the extracted seam. In western Maryland, most sinkholes develop where the soil and rock above a mine are less than fifty feet thick.

Human activity can also result in subsidence or sinkhole events. Leaking water pipes or structures that convey storm-water runoff may result in areas of subsidence as the water dissolves substantial amounts of rock over time. Poorly managed stormwater can be an exacerbating factor is subsidence events. In some cases, construction, land grading, or earthmoving activities that cause changes in stormwater flow can trigger sinkhole events.

4.3.12.2 Range of Magnitude

No two subsidence areas or sinkholes are exactly alike. Variations in size and shape, time period under which they occur (i.e., gradually, or abruptly), and the proximity to development ultimately determine the magnitude of damage incurred. Events could result in minor elevation changes or deep, gaping holes in the surface. Subsidence and sinkhole events can be addressed before significant damage occurs.

Primarily, problems related to subsidence include the disruption of utility services and damages to private and public property including buildings, roads, and underground infrastructure. Isolated incidents of subsidence throughout the coal regions over the past years have affected houses, garages, and trees that have been swallowed up by subsidence holes. Lengths of local streets and highways, and countless building foundations have been damaged.

If long-term subsident or sinkhole formation is not recognized and mitigation measures are not implemented, fractures or complete collapse of building foundations and roadways may result. The worst-case scenario of a mine subsidence event for Calvert County would be similar to an event in Allegheny County in 2013, when sixty-nine homes in Hyde Park sustained mine subsidence damage. The Maryland Department of the Environment responded to the subsidence by filling the mine voids at a cost of $3.7 million. If mitigation measures are not taken, the cost to fill in and stabilize sinkholes can be significant although sinkholes are limited in range of magnitude.

Voids in the earth’s subsurface are created where coal was previously mined and removed. The condition removes a significant portion of the support of the overlying rock strata that usually causes the rock strata to fall or subside into the voids that may damage dwellings or other surface structures above the affected areas. Mining locations across the county should be carefully noted and avoided as sites for new construction unless the proper measures are taken to ensure the mine’s soundness.

The Calvert County local planning team assigned a risk factor assessment score of 2.8 to subsidence and sinkhole formation. This places the hazard at a moderate risk factor. Based on information from the Maryland 2021 Hazard Mitigation Plan, the risk of soil movement related to subsidence and sinkholes in Calvert County is low. The northern counties in Maryland have a greater risk of sinkhole susceptibility than the southern counties. The hazard for subsidence and sinkholes in these regions is very high. Calvert County has a large portion of mining areas and is therefore one of these regions.

4.3.12.3 Past Occurrences

There is no comprehensive list of mine subsidence in Calvert County or in Maryland. The fact that no sinkholes were identified does not necessarily mean there are no sinkholes in Calvert County. Additionally, the Maryland Department of the Environment indicates that some small incidences of sinkholes occur several times per week and cause limited damage and that many of these are related to failing infrastructure like water main breaks or collapsed pipes.

4.3.12.4 Future Occurrence

There is currently no reliable information regarding the probability of future occurrence of subsidence or sinkholes in Maryland. One way of estimating the probability of future occurrences would be to project the historical trends into the future, but there is no comprehensive documentation of previous events in Calvert County. The MDE has noted that mine subsidence events are constant though they vary in intensity and damage. Based on geological conditions and mining activities in Calvert County, the annual occurrence of subsidence and sinkholes near karst topography and where mining occurs is considered likely. Although precise locations of future occurrences is difficult to predict due to site-specific conditions that contribute to sinkhole development, there are several signs that can signal potential development.

The signs include:

- Slumping or falling fence posts, trees, or foundations.
- Sudden formation of small ponds.
- Wilting vegetation.
- Discolored well water.
- Structural cracks in walls and/or floors.

Climate change may increase the frequency of subsidence in Calvert County. Climate change could result in more intense rainfall from more frequent hurricanes and tropical storms, or it could result in hot, dry areas becoming increasingly dry. The increase in precipitation could result in ground swelling, due to soils that contain clay minerals absorbing the rainfall. This swelling is seen as an increase in vertical land motion, while shrinking is the decrease in vertical land motion. Shrinking occurs when there are high temperatures that cause the land to dry out resulting in more movement in the soil, which can be seen as a gradual settling or sudden sinking of Earth’s surface. The combination of shrinking and swelling could increase with climate change and ultimately increase the frequency of subsidence and sinkholes in Calvert County.

4.3.12.5 Vulnerability Assessment

Areas of the county where commercial mining operations take place are the most vulnerable to subsidence and sinkhole hazards. Natural subsidence and sinkholes have never been reported in Calvert County. A mined area may be differentially prone to subsidence based on its geology and depth of mineral seam, but reliable information about the different locations of varying depths of seams are not available. Geologists agree that all areas that are mined are prone to subsidence; therefore, coal mined areas are shown as vulnerable to mine subsidence.

Underserved, unserved, and socially vulnerable populations face heightened impacts from subsidence and sinkholes. Limited resources often result in substandard infrastructure, exacerbating susceptibility to ground collapse. Housing in these areas is prone to structural damage, posing threats to lives and livelihoods. Displacement becomes a critical concern as sinkholes disrupt communities, challenging access to safe shelter. Vulnerable populations may lack the financial means for adequate recovery, perpetuating economic hardships.

As seen in *Table 2 – Population Change in Calvert County*, the Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. Based on this information, it can be speculated that these municipalities may have an increased/equivalent risk to subsidence and sinkholes since 2010, due to the increase in population and construction.

Impact of subsidence and sinkholes on historic properties in Calvert County

All of the historic properties that are located in Calvert County are at an increased vulnerability to subsidence and sinkhole.

Current land use in Calvert County can affect the vulnerability of the county to subsidence and sinkholes. Impervious surfaces allow pollutants from aerial and terrestrial sources to accumulate. During stormwater runoff, these pollutants will run into stormwater drains and directly to local waterbodies. When impervious surfaces increase, so does the quantity, speed, temperature, and pollutant load of the storm water runoff.

Subsidence and sinkholes present dual threats to both natural and cultural areas. Ecologically, these alter landscapes, compromising soil stability and disrupting ecosystems. Sinkholes can swallow habitats, impacting land use for the county. Culturally, the collapse of terrain endangers heritage sites, structures, and artifacts, erasing historical landscapes. Subsidence may threaten traditional agricultural practices linked to specific terrains.

Subsidence and sinkhole events can also pose a threat to systems within Calvert County. Some systems that may be affected by subsidence and sinkhole events are natural gas, water, and the numerous other materials and chemicals transported through underground water systems in Calvert County. During significant subsidence and sinkhole events, underground pipelines may crack, causing the transported material to leak into the ground and contaminating water sources in the county. Even in more contained scenarios, a small leak can have profound impact if the transported material is toxic or hazardous in nature, leading to degradation of the natural resources in the impacted communities. Subsidence and sinkhole events can also cause above ground localized transportation issues if an event were to occur along a transportation route through Calvert County. This can cause a delay in daily transportation and may require alternate transportation routes to be established for an extended period of time.

4.3.13. Tornado and Windstorm

4.3.13.1 Location and Extent

Tornadoes and windstorms can occur throughout Calvert County and are usually localized in their location and extent. Severe thunderstorms may result in conditions favorable for the formation of windstorms, including tornadoes. Tornadoes are nature's most violent storms and can cause fatalities and devastation to neighborhoods and municipalities within the county and region. Tornadoes can occur at any time during the day or night but are most frequent during the later afternoon and early evening, which are typically the warmest hours of the day. Tornadoes are most likely to occur in the spring and summer.

Tornadoes

There are two main types of tornadoes: supercell and non-supercell. Supercell tornadoes are the most common and often the most dangerous type of tornado. A rotating updraft is key to the development of a supercell and, eventually, a tornado. Once the updraft is rotating and being fed by warm air, a tornado is formed. The other type of tornado is categorized as non-supercell, which is not as common as a supercell tornado. One type of non-supercell tornado is the "Quasi-Linear Convective Systems" (QLCS). The QLCS tornadoes typically arise during the late night or early morning hours and are typically weaker and more short-lived than supercell tornadoes. However, QLCS are more difficult to detect effectively. Another type of non-supercell tornado is a landspout. These tornadoes are narrow, rope-like funnels that form when a thundercloud grows without a rotating updraft, which causes the spinning motion common with tornadoes to appear near the ground.

Windstorms

Windstorms are experienced on a region-wide scale. The most frequent cause of windstorms in Maryland are thunderstorms, although they may also be caused by hurricanes and winter storms. Windstorms are defined as sustained wind speeds of 40 mph or greater, lasting for at least one hour, or winds of 58 mph or greater lasting for any duration. There are a wide variety of windstorm events that can take place in Calvert County.

4.3.13.2 Range of Magnitude

Tornadoes

Each year tornadoes account for $1.1 billion in damages and cause over eighty deaths nationally. Thus far, 2011 was the second worst year on record for deadly tornadoes behind 1936. The number of tornado reports has increased since 1950. While the extent of tornado damage is usually localized, the vortex of extreme wind associated with a tornado can result in some of the most destructive forces on Earth. The damage caused by a tornado is a result of the high-wind velocity and windblown debris, also accompanied by lightning or large hail. The most violent tornadoes have rotating winds of 250 mph or more and are capable of causing extreme destruction and turning normally harmless objects into deadly projectiles.

Tornado movement is characterized in two ways: direction/speed of spinning winds and the forward movement of the tornado, also known as the storm track. The rotational wind speeds can range from 65 to more than 200 miles per hour (mph). The speed of forward motion can range from 0 mph to 50 mph. Forward motion of a tornado path can be a few to several hundred miles in length. Widths of tornadoes vary from less than 100 feet in diameter to more than a mile wide in regard to the largest tornadoes on record. The National Centers for Environmental Information (NCEI) reports that, "the maximum winds in tornadoes are often confined to extremely small areas and vary tremendously over short distance," which explains why one house in a tornado's path may be completely demolished while a neighboring house could remain untouched. Some tornadoes never touch the ground and remain short lived, while others may touch the ground or "jump" along its path.

The destruction from tornadoes can range from minor to severe depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light-weight construction, such as mobile homes. The Enhanced Fujita Scale, also known as the "EF-Scale", measures tornado strength and associated damages. The EF-Scale is an update to the earlier Fujita Scale, also known as the "F-Scale", that was published in 1971. These scales classify U.S. tornadoes into six intensity categories based upon the estimated maximum winds occurring within the wind vortex. This scale can be seen in *Table 46 – Enhanced Fujita Scale*. The EF-Scale became effective on February 1, 2007. Since its implementation by the National Weather Service in 2007, the EF-Scale has become the definitive metric for estimating wind speeds within tornadoes based upon damage to buildings and structures. Previously recorded tornadoes are reported with the older F-Scale values, but *Table 46 – Enhanced Fujita Scale* shows F-Scale categories with corresponding EF-Scale wind speeds.

Figure 28 – Maryland Wind Zones identifies wind speeds that could occur across the state, which may be used as the basis for design and evaluation of the structural integrity of shelters and critical facilities. The majority of Maryland falls within Zone II, meaning that the design of shelters and critical facilities should be able to withstand a three-second gust of up to 160 mph, regardless of whether the gust is a result of a tornado, hurricane, tropical storm, or windstorm incident.

Since Calvert County falls within Zone II, shelters and critical facilities should be designed to withstand up to 160 mph winds, regardless of whether the gust is the result of a tornado, coastal storm, or windstorm event.

Tornadoes/windstorms of all types have caused the following problems in Calvert County:

- Power failures lasting four hours or longer.
- Loss of communications networks lasting four hours or more.
- Residents requiring evacuation or provision of supplies or temporary shelter.
- Severe crop loss or damage.
- Trees down or snapped off high above the ground/tree debris-fire fuel.
- Toppled high profile vehicles, including those containing hazardous materials.

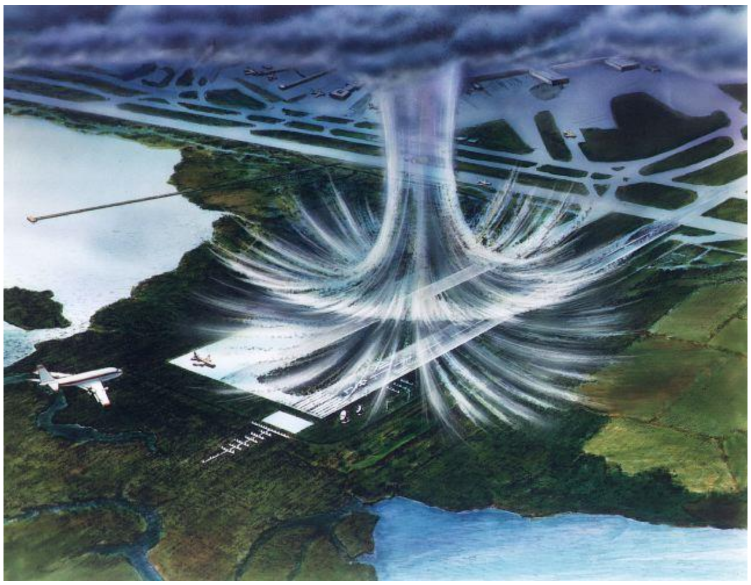
Table 46 - Enhanced Fujita Scale

Enhanced Fujita Scale			
EF-Scale Number	**Wind Speed (MPH)**	**F-Scale Number**	**Description of Potential Damage**
EF0	65–85	F0-F1	**Minor damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	86-110	F1	**Moderate damage**: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111–135	F1-F2	**Considerable damage**: Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136–165	F2-F3	**Severe damage**: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166–200	F3	**Devastating damage**: Well-constructed houses and whole frame houses completely leveled; cars thrown, and small projectiles generated.
EF5	>200	F3-F6	**Extreme damage**: Strong frame houses leveled off foundations and swept away; automobile-sized projectiles fly through the air in excess of 100 m (300 ft.); steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation.
Source: NWS, 2007			

Most of the tornadoes that have struck Calvert County have occurred countywide.

Windstorms

Windstorms can be broken down into multiple categories. Straight-line winds are the most common wind event and are different from tornadic winds. It is a ground level, non-rotational, wind that comes out of a thunderstorm. Downdrafts are columns of air that rapidly sinks toward the ground and are classified as either a microburst or microburst. A macroburst is the outward burst of strong winds that are near or at the surface with horizontal dimensions greater than 2 ½ miles. Macrobursts winds may begin over a smaller area and then spread out to a wider area, sometimes producing damage similar to a tornado. On the other hand, microbursts are smaller outward bursts of strong winds near or at the surface. Microbursts are less than 2 ½ miles in horizontal dimension and are typically short-lived winds that last a maximum of ten minutes, with windspeeds reaching up to 100 mph. Microburst events can be wet or dry events. Wet microbursts are typically associated with heavy precipitation at the surface. Dry microbursts do not have precipitation associated with them and are commonly found in the western portion of the United States.



A gust front is characterized by wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Derecho is a long-lived windstorm that is associated with a band of rapidly moving showers or thunderstorms. A typical derecho contains various downbursts and microbursts. If the wind damage is more than 240 miles and includes wind gusts of at least 58 mph, the event would then be classified as a derecho.

4.3.13.3 Past Occurrence

Calvert County has experienced eighteen tornado events since 1978, and sixteen wind incidents between 1996 and spring of 2020 as seen in *Table 47 – Calvert County Tornado History* and *Table 48 – Calvert County High Wind History*. Numerous sources provide information in regard to past occurrences and losses associated with tornadoes/windstorms in Calvert County and the state as a whole. Due to the number of sources available with information, specific number of events and losses could vary slightly between sources. Tornado data and windstorm data was only available until 2022, even though more recent events could have possibly occurred. Historically, the county has experienced both severe windstorms and tornadoes. The most recent tornado impacted Breezy Point on August 4th, 2020. *Figure 27 – Number of Tornados by county in Maryland* illustrates the number of tornados per county as reported by the National Risk Inventory (NRI), as published by FEMA.

Table 47 - Calvert County Tornado History

Calvert County Tornado History					
Location	**Date**	**Magnitude (F/EF Scale)**	**Deaths**	**Injuries**	**Property Damage ($)**
Countywide	06/27/1978	F2	0	0	250,000.00
Countywide	09/05/1979	F1	0	1	250,000.00
Countywide	10/13/1983	F2	0	0	25,000.00
Countywide	05/08/1984	F0	0	0	25,000.00
Countywide	08/17/1994	F0	0	0	500.00
Dunkirk	07/13/1996	F1	0	0	120,000.00
Dunkirk	04/21/2000	F1	0	0	210,000.00
Chaney	05/13/2000	F1	0	1	20,000.00
Solomons	05/22/2001	F0	0	0	0
Bowens	04/28/2002	F2	2	0	10,000,000.00
Long Beach	04/28/2002	F1	0	0	5,000.00
Solomons	09/28/2004	F0	0	0	40,000.00
Paris	06/04/2008	EF0	0	0	400,000.00
Appeal	04/28/2011	EF0	0	0	7,000.00
Buena Vista	08/07/2012	EF0	0	0	0
Coster	02/21/2014	EF0	0	0	0
Coster	08/04/2020	EF0	0	0	250,000.00
Breezy Pt	08/04/2020	EF1	0	0	0
		Totals:	2	2	11,602,000.00
Source: NOAA NCEI, 2023 Estimated Values are marked*					

Table 48 - Calvert County High Wind History

Calvert County High Wind History				
Location	**Date**	**Magnitude (knots)**	**Injuries**	**Property Damage ($)**
Calvert (Zone)	07/13/1996	n/a	0	60,000.00
Calvert (Zone)	10/08/1996	67	0	30,000.00
Calvert (Zone)	01/13/2000	n/a	0	5,000.00
Calvert (Zone)	01/14/2006	52	0	75,000.00
Calvert (Zone)	09/01/2006	50	0	165,000.00
Calvert (Zone)	04/16/2007	50	0	10,000.00
Calvert (Zone)	05/11/2008	50	2	100,000.00
Calvert (Zone)	02/19/2011	52	0	1,000.00
Calvert (Zone)	02/25/2011	50	0	0
Calvert (Zone)	10/29/2012	56	0	812,880.00
Calvert (Zone)	02/14/2015	50	0	0
Calvert (Zone)	04/03/2016	50	0	0

Calvert County High Wind History				
Location	**Date**	**Magnitude (knots)**	**Injuries**	**Property Damage ($)**
Calvert (Zone)	02/12/2017	50	0	0
Calvert (Zone)	03/02/2018	60	0	0
Calvert (Zone)	10/11/2018	52	0	0
Calvert (Zone)	04/13/2020	55	0	0
		Totals:	2	1,259,000.00
Source: NOAA NCEI, 2023 Estimated Values are marked*				

4.3.13.4 Future Occurrence

In the United States, tornado activity has increased in variability, with a general decrease in the number of days a year on which activity occurs, but an increase in the number of tornadoes on those days. This indicates an increase in tornado outbreaks. The future probability of a disastrous tornado occurring in Calvert County is ranked as possible, but not highly likely. While the chance of being hit by a tornado in Calvert County is small, the damage that results when the tornado arrives can be devastating. An EF-5 tornado, with a 0.019% annual probability of occurring, can carry wind velocities of 200 mph, resulting in a force of more than 100 pounds per square foot of surface area. This is a “wind load” that exceeds the design limits of most buildings in Maryland. As jurisdictions within the county grow, and as residential and commercial construction continues, the number of people and properties will be greatly affected by tornadoes and windstorms as they increase accordingly.

Based on historic patterns, tornadoes are unlikely to remain on the ground for long distances, especially in areas of the country with hilly terrain, such as the majority of Maryland. However, the high historical number of windstorms with winds at or over 50 knots indicates that the annual chance of a windstorm in the county is uniquely high. The annual tornado seasoning has begun to lengthen, with the season starting earlier than it has historically and ending later. Maryland had, for example, a record number of tornadoes in April and May of 2019 compared to any other April and May on record. Climate change is causing temperatures and air moisture to increase, increasing the frequency and intensity of tornadoes and windstorms. There remains some uncertainty regarding the recurrence of tornadoes. Therefore, the number of future tornadoes and windstorm events could potentially increase due to known and unknown factors.

Based on historical incidents, there are three zones in Maryland that can either experience less than one, one to four, or five to ten of EF-2 or above tornadoes per 3,700 square miles. Communities in Calvert County, as shown in *Figure 29 – Tornado Activity in Calvert County* below, are expected to have minor occurrences of tornados approximately every one to three years. The approximation of one to four tornadoes annually assists with determining the rate of future tornado occurrences within Calvert County. Future tornadoes will be similar to those that affected the county in past events.

Windstorm events occur on a more frequent basis compared to tornadoes. Calvert County, specifically, experiences windstorm events more commonly than tornadoes, which causes power failure, loss of communication networks, and residents requiring temporary shelters and provision of supplies. Therefore, unlike tornadoes, this hazardous event has a highly likely probability for future events to occur within the county.

Climate change and its relationship with tornado outbreaks is hard to identify. Some recent studies suggest that as average temperatures begin to rise, so will the intense storms that often lead to the creation of tornadoes. Warm, moist air is the most important aspect for developing strong tornadoes. Climate change can exacerbate this, and it could potentially lead to an increase in frequency and the severity of the events. Although not yet proven, this is one of the most prevalent theories on how climate change can impact tornado frequency and intensity.

4.3.13.5 Vulnerability Assessment

The frequency of windstorms and minor tornadoes is expected to remain relatively constant, vulnerability increases in more densely developed areas. Factors that impact the amount of damage caused by a tornado include the strength of the tornado, the time of day, and the area of impact. Usually, such distinct funnel clouds are localized phenomena impacting a small area. However, the high winds of tornadoes make them one of the most destructive natural hazards. There can be many cascading impacts of tornadoes and windstorms including, but not limited to, transportation accidents, hazardous material spills, flooding, and power outages. A proper warning system is vital for the public to be informed of what to do and where to go during such events.

Additional dangers that accompany tornado-associated thunderstorms, and which increase the vulnerability of Calvert County, include:

- Flash floods – 146 deaths annually nationwide.
- Lightning – 75 to 100 deaths annually nationwide.
- Damaging straight-line winds – reaching 140 mph wind speed.
- Large hail – can reach the size of a grapefruit and can cause several million in damages annually to property and crops

The economy of Calvert County is highly vulnerable to tornadoes. While there may be severe impact on financial and commercial systems of the economy, these storms, and the damage they cause, can disrupt business long-term. The local economy is vulnerable due to the possibility of being crippled by tornadoes and windstorms and their cascading effects when buildings and supporting infrastructure are destroyed in a storm. Power outages can create work stoppages, while transportation accidents and road closures can limit transportation of goods and services.

Additionally, flooding cannot be discounted as it can destroy physical structures, merchandise, and equipment essential for business operation.

Calvert County's environment is also vulnerable to tornado events. However, since tornado events are typically localized, environmental impacts are rarely widespread. The impact of windstorms on the environment typically takes place over a large area. In either case, where these events occur, severe damage to plant species is likely. This includes uprooting or total destruction of trees and an increased threat of wildfire in areas where dead trees are not removed. Most notably, hazardous material spills can pollute ground water systems and vegetation. In the case of hazardous material spills, the local environment can be negatively impact and can cause extensive cleanup and mitigation efforts. Calvert County is considered a rural county that has a great amount of tourism that occurs in the surrounding hills, mountains, beaches, and state parks. Not only is the environment at risk to tornadoes and windstorms, but hikers, tourists, and hunters are also at risk when out in the environment. Consequently, in the event of a tornado or severe storm, these tourists have limited emergency notification measures which result in high vulnerability. A storm has the ability, potentially, to destroy structures, damage private and public property, and injure citizens and tourists to the area. People with disabilities, the elderly, functional needs, and non-English speaking residents are more vulnerable to tornadoes, windstorms, and their cascading effects. Without assistance to evacuate and/or seek shelter, and with potential difficulty understanding information, these at-risk populations may be unable to prepare themselves, or their homes and other possessions, to safely endure the storm.

Tornado, windstorm, and cascading events may affect a small portion, or the entirety, of the county. Therefore, it is important to identify specific critical facilities and assets that are most vulnerable to this hazard. Critical facilities are highly vulnerable to windstorms and tornado events. While many severe storms can cause exterior damage to structures, tornadoes can destroy structures, along with their surrounding infrastructure, immediately halting their function. Tornadoes are often accompanied by severe storms which can be threatening to critical facilities within the county. Many secondary effects from these disasters can jeopardize the operation of these critical facilities as well. Critical facilities are particularly vulnerable to power outages which can leave facilities functionless, potentially crippling infrastructure supporting the population of the county.

As seen in *Table 2 – Population Change in Calvert County*, the Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. Based on this information, it can be speculated that these Municipalities may have an increased/equivalent vulnerability to tornado and windstorms, since 2010, due to the increase in population and construction.

Land use, in the form of a built environment, such as residential expansion, can cause tornado impact severity to increase. Impact severity increases when built environment expansion provides an influx of people, infrastructure, and critical infrastructure in harm's way. Since the population in Calvert County had a minor overall increase between 2010 and 2020, it can be speculated that the built environment did not increase significantly.

Impact of tornados on historic properties in Calvert County

All of the historic properties that are located in Calvert County are at an increased vulnerability to tornados and high wind events. Based on the half mile vulnerability zone used in the mapping analysis, there are five historic properties that are within that vulnerability zone of past tornado tracks in Calvert County. These properties are: All Saints' Church, Chesapeake Beach Railway Station, the Joseph Lyons House, La Veille, and the Patterson Archaeological and Historic District. Although these areas are located near past tornado tracks, the entire county should be considered, due to the difficulty predicting locations of tornado development.

Figure 27 - Number of Tornados by county in Maryland

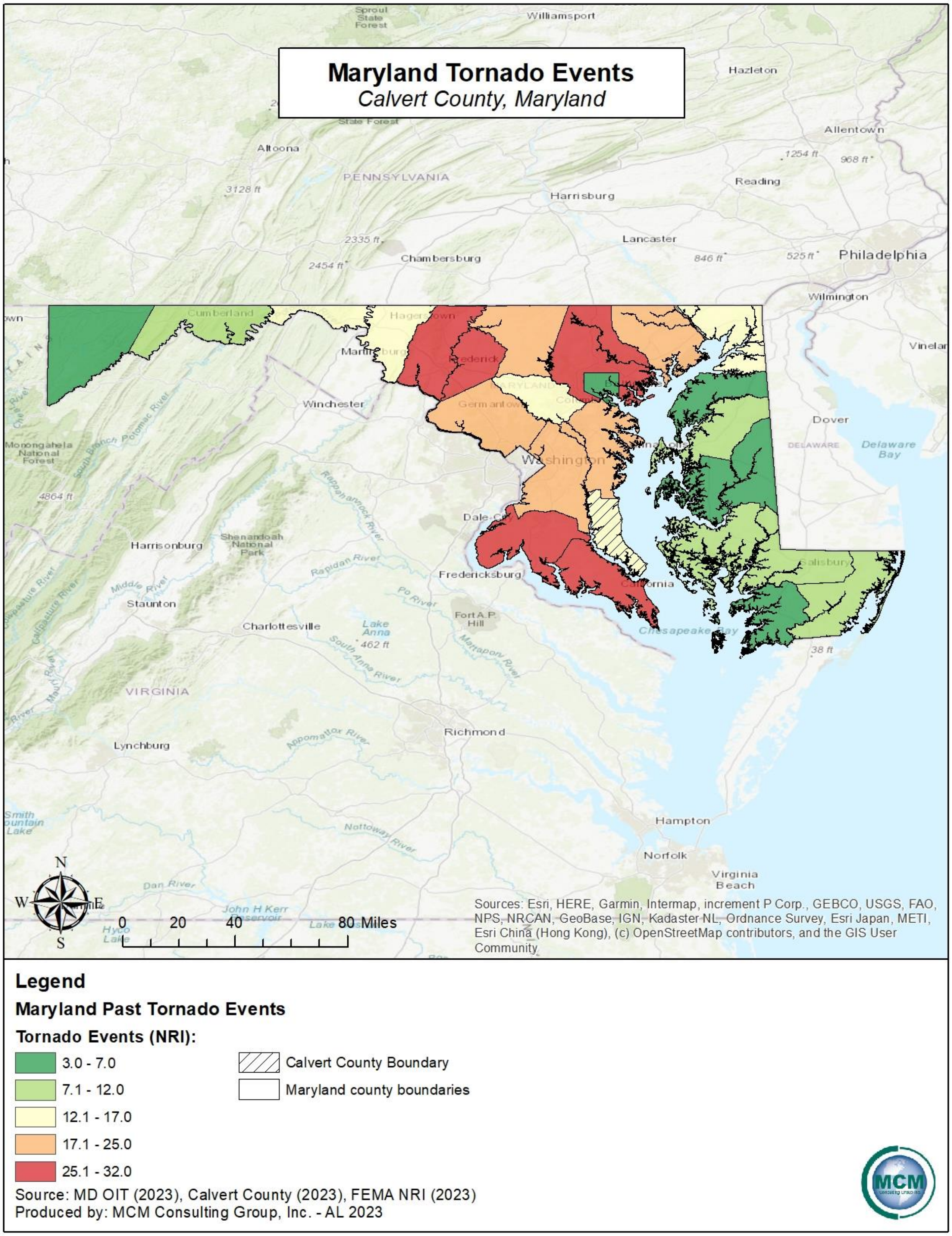


Figure 28 - Maryland Wind Zones

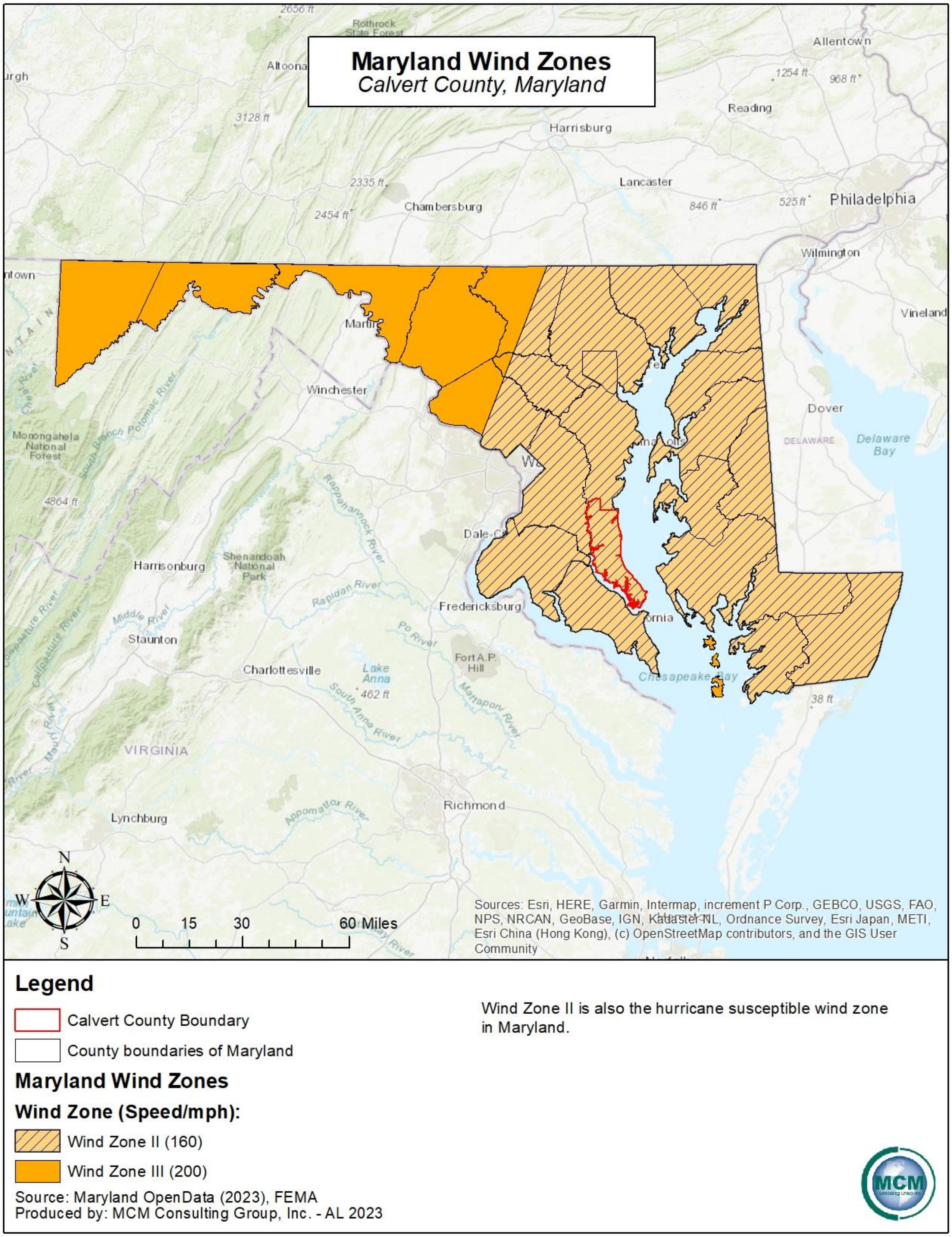
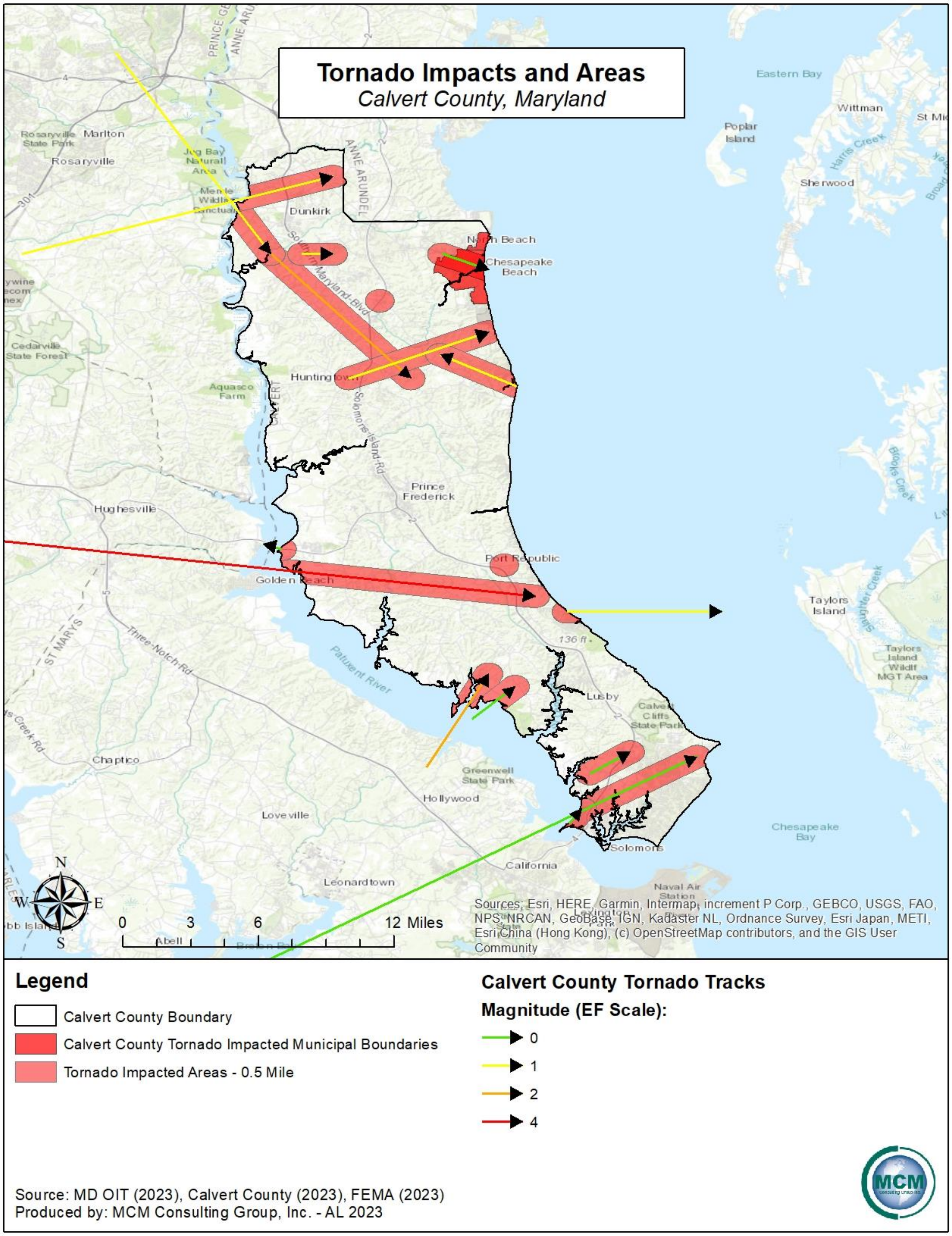


Figure 29 - Tornado Activity in Calvert County



4.3.14. Wildfire

4.3.14.1 Location and Extent

The most prevalent causes of devastating wildfires are droughts, lighting strikes, arson, human carelessness, and in rare circumstances, spontaneous combustion. Most fires in Maryland are caused by anthropogenic fires such as debris burns that spread and get out of control. A fire, started in somebody's backyard, could travel through dead grasses and weeds into bordering woodlands starting a wildfire. Major urban fires can cause significant property damage, loss of life, and residential or business displacement. While wildfires are a natural and essential part of many native Maryland ecosystems (e.g., pitch pine and scrub oak woodlands), wildfires can also cause devastating damage if they are undetected and allowed to propagate unfettered. Wildfires most often occur in less developed areas such as open fields, grass, dense brush, or forests where they can spread rapidly by feeding off of vegetation and combustible fuels. Wildfires are most prevalent under prolonged dry and hot spells, or general drought conditions.

A large portion of Calvert County is covered by either farmland or forested areas increasing the geographic extent of wildfire vulnerability in the county. Under dry conditions or droughts, wildfires have the potential to burn forests as well as croplands. For recreational enjoyment, the county boasts several local parks and natural areas that include a series of trail systems – all of which are at risk for wildfires.

4.3.14.2 Range of Magnitude

Forested areas, croplands and properties that are at the interface between wild lands and human development are most at risk for being impacted by and causing wildfires. If an urban fire or wildfire is not contained, secondary impacts including power outages may result. Other negative impacts of wildfires can include death of people, livestock, fish, and wildlife, and destruction of valuable property, timber, forage, recreational and scenic values. Wildfires can also cause severe erosion, silting of stream beds and reservoirs, and flooding due to a loss of ground cover.

Almost all of the wildfires in the county occur in remote areas or areas away from residential structures. Unlike the wildland fires that occur in other parts of the country and affect vast areas of land and residential communities, most fires in Calvert County are contained before they cause damage or extensive property loss. However, the county recognizes that wildfires of some magnitude will continue to occur in Calvert County and will have more detrimental effects if development in and/or around the natural areas increases.

The United States Forest Service utilizes the Forest Fire Assessment System to classify the dangers of wildfire. *Table 49 – Wildland Fire Assessment System* identifies each threat classification and provides a description of the level.

Table 49 - Wildland Fire Assessment System

Wildland Fire Assessment System *(U.S. Forest Service)*	
Rank	**Description**
Low (L)	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
Moderate (M)	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.
High (H)	All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High (VH)	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme (E)	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes, or the fuel supply lessens.
Source: U.S. Forest Service	

4.3.14.3 Past Occurrence

The Maryland Department of Natural Resources (MDNR) and the National Climatic Data Center have the most up to date records on wildfire events in Calvert County and Maryland as a whole. Historically, Calvert County experiences small fires on an annual basis. However, due to the many acres of farmland, forested areas, and open space in the county, under the right conditions the potential exists for a significant wildfire.

Past events for wildfires from the National Climatic Data Center (NCDC) shows that there have been no recorded wildfire events in Calvert County from 1996 to 2023. This does not mean that there were no wildfires in that time, only that there were no reported, recorded, or observed wildfires sent to NOAA.

Table 50 – Annual Summary of Wildfire Events illustrates number of wildfires for the state of Maryland per year, and the number of acres burned for every county in Maryland from 2016 to 2022. Information for 2023 was not available at the time of this writing.

Table 50 - Annual Summary of Wildfire Events

Annual Summary of Wildfire Events		
Year	**Number of Fires**	**Acres**
2016	41	1,120.3
2017	56	1,494.8
2018	59	1,299.5
2019	138	1,493.2
2020	76	1,421.5
2021	102	1,363
2022	124	3,121.9
Total:	**596**	**11,314.2**
Source: MDNR, 2023		

In recent years, the number of prescribed burns in Maryland has been increasing. This corresponds to an understanding of the need for fire in many natural ecosystems and management strategies for reducing vulnerability to wildfire; it also improves hunting opportunities.

4.3.14.4 Future Occurrence

Annual occurrence of urban fires and wildfires in Calvert County are expected. Urban fires are most often the result of human errors, outdated wiring and occasionally, malintent (arson). The occurrence of large scale and intense wildfires is somewhat unpredictable and highly dependent on environmental conditions and human response. Weather conditions play a major role in the occurrence of wildfires, so in the event of drought conditions, wildfire caution should be heightened. Any fire without the quick response or attention of firefighters, forestry personnel, or visitors to the forest, has the potential to become a wildfire.

Climate change is expected to bring an elongated wildfire season and more intense and long-burning fires (Pechony & Shindell, 2010). In some regions of the United States, this is a very real concern. Northern California has experienced unprecedented devastating wildfires in 2017, 2018, 2019, 2020, 2021, 2022, and 2023. Wildfires in Ontario have impacted east coast states including most of the northeastern seaboard including Maryland. This primarily occurred in 2022 and 2023. The fires that have been occurring in California are thought to be burning faster and hotter due to worsening drought conditions caused by increased climate change (Cvijanovic et al., 2017). Wildfire conditions in Maryland are not nearly as severe as in Northern California, but the intensification is a signal that the changes brought by climate change are relevant to wildfires. In Maryland, higher air temperatures and earlier warming in the spring are expected to continue, resulting in more wildfire prone conditions in the summer and fall (Shortle et al., 2015).

Climate change significantly influences wildfires by altering environmental conditions. Rising temperatures, prolonged droughts, and changes in precipitation patterns create drier landscapes, fostering the ignition and rapid spread of wildfires. Elevated temperatures contribute to increased evaporation, drying out vegetation and creating more fuel for fires. Altered precipitation patterns can lead to extended periods of drought, further desiccating ecosystems. Climate change also affects the timing and intensity of seasons, extending the fire-prone period. Additionally, warming temperatures facilitate the expansion of pests and diseases that weaken trees, making forests more susceptible to ignition.

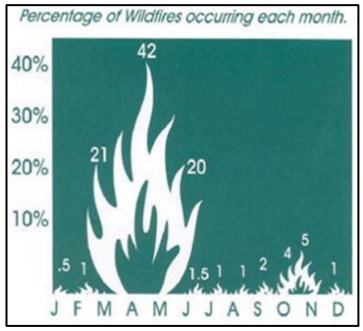
4.3.14.5 Vulnerability Assessment

The size and impact of a wildfire depends on its location, climate conditions, and the response of firefighters. If the right conditions exist, these factors may often mitigate the effects of wildfires; however, during a drought, wildfires can be devastating. The highest risk for wildfires in Maryland occurs during the spring (March to May) and the fall (October to November) months and 99% of all wildfires in Maryland are caused by people. Approximately 83% of all Maryland wildfires occur in the months outlined above. In the spring, bare trees allow sunlight to reach the forest floor, drying fallen leaves and other ground debris and increasing wildfire vulnerability. In the fall, the surplus of dried leaves is fuel for fires. *Figure 30 – Seasonal Wildfire Percentage* shows the wildfire percentage occurrence during each month in Maryland.

Firefighters and other first responders can encounter life-threatening situations due to forest and wildfires. Traffic accidents during a response and the impacts of fighting the fire once on scene are examples of first responder vulnerabilities.

The Wildland Urban Interface (WUI) was nationally mapped by a United States Department of Agriculture Forest Service effort in 2015 that used data from 1990-2010 to develop a robust dataset that related housing density and vegetative density. The dataset provides a way to identify locations where larger numbers of people are living in or near natural areas that could be at risk in the event of a wildfire. The WUI defines two types of communities – interface and intermix. Intermix refers to areas where housing and wildland vegetation intermingle, and interface refers to areas where housing is in the vicinity of a large area of dense wildland vegetation. The WUI was the fastest-growing land use type in the United States between 1990 and 2010. Factors behind the growth include population shifts, expansion of cities into the wildlands, and the expansion of new vegetation growth. The primary cause has been the migration of people, not vegetation growth.

Figure 30 - Seasonal Wildfire Percentage



Maryland is among the states with the largest WUI and the most housing units in a WUI designated area. Marylanders desire the proximity of natural beauty in their daily lives, and the growth in WUI housing noted above illustrates this. Wildfire hazard is defined by conditions that affect wildfire ignition and/or behavior such as fuel, topography, and local weather. The many addressable structures in the Wildland Urban Interface and Intermix zones are broken up by assessed parcel use codes.

There are nine fire departments that serve Calvert County, a list of which can be seen in *Table 63* of the emergency services profile. Each fire department conducts its own schedule of in-house training sessions for its members.

The response of firefighters is integral to the containment of wildfires in the county. There is a potential for fire stations and services to close, which affects response to a wildfire in Calvert County**.** *Figure 32 – Fire Station Locations* illustrates the position of fire stations and the location of state game lands, state forests, and natural areas within Calvert County. It is recommended that each municipality assess vulnerabilities to department closures by building a relationship with their local providers and planning accordingly for if a local service were to close.

At the time of the writing of this plan, it is possible that continuing emergency service shortages across Maryland will impact the availability of firefighters and their response times. Many fire departments have created and begun to enforce new regulations regarding responding to emergencies during a pandemic and with pandemic impacts still occurring in a jurisdiction.

Crops and farmland are at an increased risk of wildfires within Calvert County. As previously discussed, Calvert County has a large market share in agricultural production, and these economic income streams could be negatively impacted or destroyed by a significant wildfire event. Many acres in Calvert County (25,152 acres) are at an increased vulnerability. Few critical infrastructure facilities and community lifelines are at an increased risk from wildfires, as most of the facilities can be found in more urban, and more densely populated areas. Wildfires occur most frequently in rural areas, so the areas of vulnerability do not directly overlap.

A major aspect of wildfires includes the impact of smoke and particulate matter that can result from a large wildfire. Smoke and particulate air pollution can cause poor air quality and unhealthy conditions for areas directly adjacent to, or far away from, a wildfire.

In June of 2023, a large portion of the eastern United States was affected by smoke, haze, particulate matter, and poor air quality as a result of wildfires in eastern and southern Canada (Nova Scotia and Quebec). Air currents resulted in smoke and atmospheric effects from the wildfires following areas of low pressure and settling over the mid-Atlantic region including Pennsylvania, New York, New Jersey, Maryland, and parts of Ohio. New York City had the lowest air quality of any city on the planet on June 7, 2023, as reported by multiple news outlets including CBS and NBC. Maryland saw a large impact from the smoke and particulate matter and the northern areas of Maryland saw air quality labeled unhealthy. Most of the smoke and particulate matter impacts occurred in Maryland from June 5, 2023 to June 9, 2023. Another time frame of concern was June 29th, 2023 to June 30th, 2023.

The smoke and haze from the Canadian wildfires reduced visibility in Maryland, caused a smokey, campfire like odor in the air, and caused health issues for the population. Images of the skylines in major cities were impacted by smoke. Individuals across Maryland, including Calvert County, reported health effects like headaches, irritated eyes and sinuses, fatigue, difficulty breathing, chest pains, asthma attacks, irritated throats, and an increase in coughing. This type of impact is common in areas near a wildfire but was a first for such a large portion of the eastern United States from one fire. This type of event will become more common with the changes brought about by climate change. As wildfire events become more common and stronger, smoke and particulate matter pollution will become more common over larger areas of the world.

As seen in *Table 2 – Population Change in Calvert County*, the Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. Based on this information, it can be speculated that these Municipalities may have an increased risk to wildfires, since 2010, due to the increase in population. Unserved, underserved, and socially vulnerable populations within Calvert County may be at an increased vulnerability to wildfires. This is because these populations may not have access to or the ability to relocate during wildfire events. Those that are unsheltered within Calvert County have an increased vulnerability to wildfire events due to being openly exposed to the elements, such as bad air quality from the smoke that wildfires produce.

Calvert County promotes fishing, hunting, camping, hiking, canoeing, and other outdoor activities, these land use events can increase the risk of wildfires starting. Approximately 58% of Calvert County is made up of forests, and 2% is made up of streams, and wetland areas. Natural areas can be extremely vulnerable to wildfires within Calvert County. Ecologically, these alter landscapes, compromising soil stability and disrupting ecosystems. Conditions of drought or invasive species that could damage forested areas can lead to wildfires. Wildfires can lead to devastation which can foster landslides and flash flood events. These events can destroy the forested terrain within the county and consume acres of traditional agricultural practices in a short amount of time. In addition to wide spread burning that wildfires cause, these events also pollute the air quality within the county and surrounding areas, as well as waterways due to run off and the settling of the air pollution to ground level.

Table 51 - Air Quality Index Ranking Values

Air Quality Index (AQI) Ranking Values	
Description	**Index Value**
Good	0-50
Moderate	51-100
Unhealthy for Sensitive Groups	101-150
Unhealthy	151-200
Very Unhealthy	201-300
Hazardous	301-500
Source: AirNow.gov, EPA, 2023	

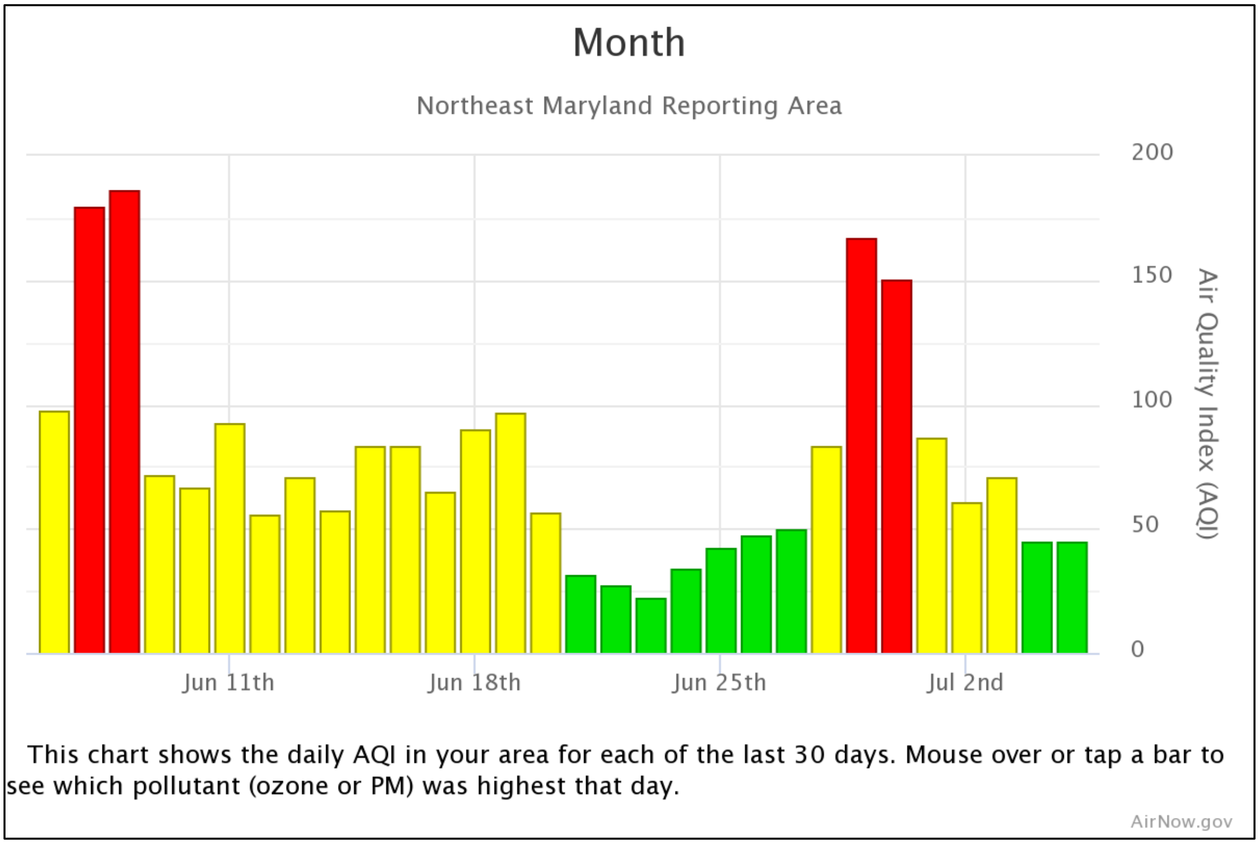
Below are daily air quality index values for June 7th, 2023 for reporting areas in Maryland. This information is presented in *Table 52 – Air Quality Index Values for Reporting Areas in MD (06/08/2023)*.

Table 52 - Air Quality Index Values for Reporting Areas in MD (06/08/2023)

Air Quality Values for Reporting Areas in MD – 06/08/2023		
Reporting Areas	Daily AQI for PM 2.5	AQI Ranking
Hagerstown	156	Unhealthy
Lower Eastern Shore	162	Unhealthy
Maryland Piedmont	N/A	N/A
Metro Baltimore	181	Unhealthy
Northeast Maryland	187	Unhealthy
Northern Baltimore	173	Unhealthy
Southern Maryland	N/A	N/A
Suburban DC	181	Unhealthy
Upper Eastern Shore	186	Unhealthy
Western Maryland	64	Moderate
Source: AirNow.gov, EPA, 2023		

Figure 31 – Northeast Maryland Air Quality (Past Month) illustrates the Northeast Maryland reporting area air quality for the past thirty days as of the time of this writing. Calvert County is not in the Northeast reporting area, but this is the only data available from AirNow.gov. The large jump in unhealthy air quality for the weeks of June 4th, 2023 to June 11th, 2023 and June 28th, 2023 to June 30th, 2023 are directly related to the issues from wildfires.

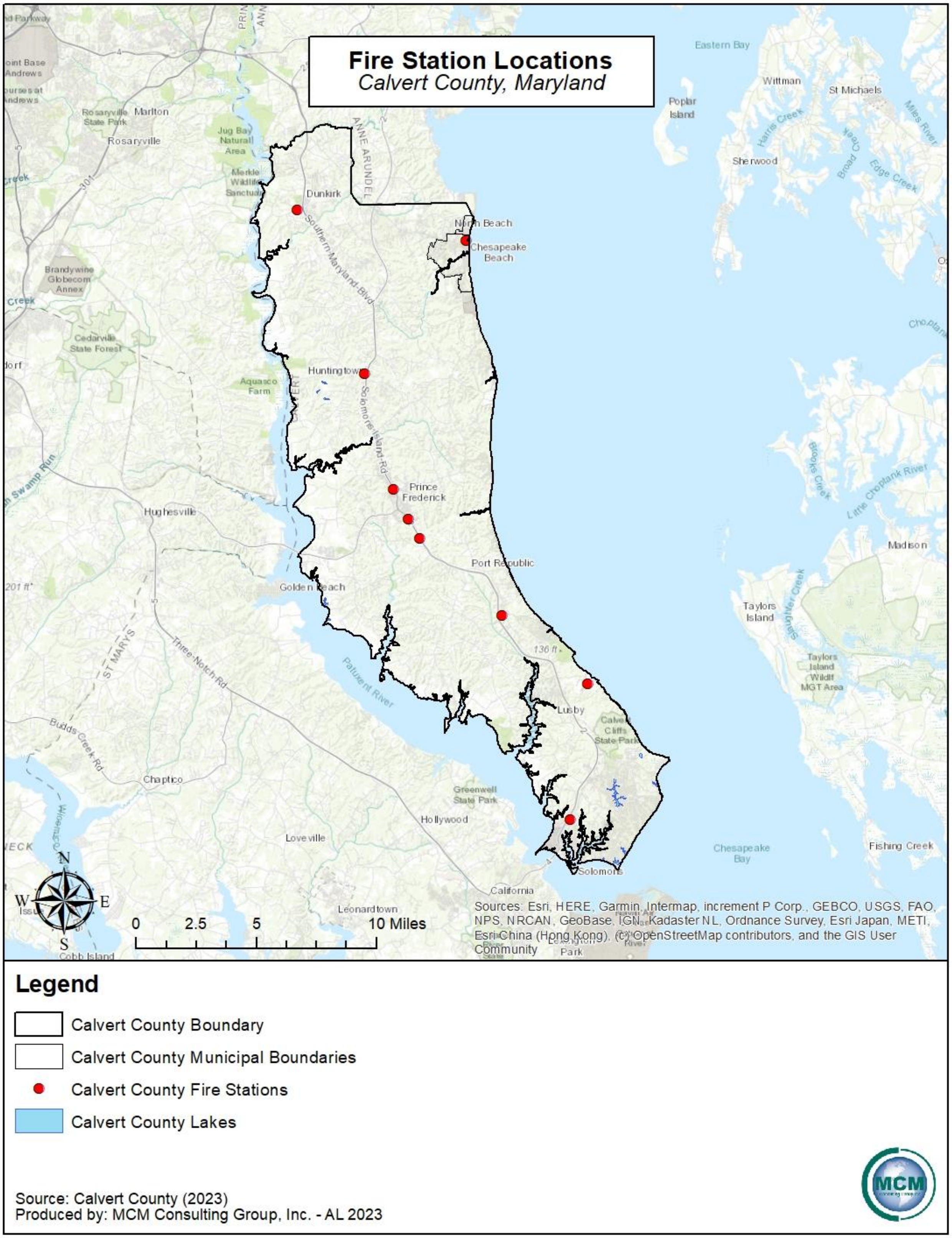
Figure 31 - Northeast Maryland Air Quality (Past Month)



Impact of wildfires on historic properties in Calvert County

All of the historic properties that are located in Calvert County are at an increased vulnerability to wildfire events. Each property is of a construction type that would be vulnerable to wildfires in Calvert County. The majority of the historic properties in the county are constructed out of brick and stone, with wooden interiors that would be destroyed by fires. Also, only three historic places are within 2 miles of a fire station in Calvert County. These locations are: the Chesapeake Beach Railway Station, the Drum Point Lighthouse, and Linden. All other historic properties in the county are farther away from fire station locations, and could result in a longer response time to fires.

Figure 32 - Fire Station Locations



4.3.15. Winter Storm

4.3.15.1 Location and Extent

Most severe winter storm hazards include heavy snow (snowstorms), blizzards, sleet, freezing rain, and ice storms. Since most extra-tropical cyclones (mid-Atlantic cyclones locally known as Northeasters or Nor'easters), generally take place during the winter weather months, these hazards have also been grouped as a type of severe winter weather storm. According to the Maryland State Hazard Mitigation Plan (MD HMP), winter storms are frequent events for the state and occur from late October until mid-April. These types of winter events or conditions are further defined below.

- **Heavy Snow:** According to the National Weather Service (NWS), heavy snow is generally snowfall accumulating to four inches or more in depth in twelve hours or less; or snowfall accumulating to six inches or more in depth in twenty-four hours or less. A snow squall is an intense but limited duration, period of moderate to heavy snowfall, also known as a snowstorm, accompanied by strong, gusty surface winds and possibly lightning.
- **Blizzard:** Blizzards are characterized by low temperatures, wind gusts of thirty-five miles per hour (mph) or more and falling and/or blowing snow that reduces visibility to 1/4-mile or less for an extended period of time (three or more hours).
- **Sleet of Freezing Rainstorm:** Sleet is defined as pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes. These pellets of ice usually bounce after hitting the ground and other hard surfaces. Freezing rain is rain that falls as a liquid but freezes into glaze upon contact with the ground.
- **Ice Storm:** An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous and can create extreme hazards to motorists and pedestrians.
- **Extra-Tropical Cyclone:** Sometimes called mid-latitude cyclones, are a group of cyclones defined as synoptic scale, low pressure, weather systems that occur in the middle latitudes of the Earth. These storms have neither tropical nor polar characteristics and are connected with fronts and horizontal gradients in temperature and dew point otherwise known as "baroclinic zones". Extra-tropical cyclones are everyday weather phenomena which, along with anticyclones, drive the weather over much of the Earth. These cyclones produce impacts ranging from cloudiness and mild showers to heavy gales and thunderstorms. Tropical cyclones often transform into extra-tropical cyclones at the end of their tropical existence, usually between 30˚ and 40˚ latitude, where there is insufficient force from upper-level shortwave troughs riding the westerlies (weather systems moving west to east) for the process of extra-tropical transition to begin. A shortwave trough is a disturbance in the mid or upper part of the atmosphere which induces upward motion ahead of it. During an extra-tropical transition, a cyclone begins

to tilt back into the colder air mass with height, and the cyclone's primary energy source converts from the release of latent heat from condensation to baroclinic processes.

4.3.15.2 Range of Magnitude

The magnitude or severity of a severe winter storm depends on several factors including a region's susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and time of occurrence during the day (e.g., weekday versus weekend), and time of season. The extent of a severe winter storm can be classified by meteorological measurements, such as those above, and by evaluating its societal impacts.

The Northeast Snowfall Impact Scale (NESIS) categorizes snowstorms in this manner. Unlike the Fujita Scale (tornado) and Saffir Simpson Scale (hurricanes), there is no widely used scale to classify snowstorms. NESIS was developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service and rank high impact, northeast snowstorms. These storms have large areas of ten-inch snowfall accumulations and greater. NESIS has five ranking categories: Notable (1), Significant (2), Major (3), Crippling (4), and Extreme (5). These ranking can be seen in *Table 53 – NESIS Winter Storm Rankings*. The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus, NESIS gives an indication of a storm's societal impacts. This scale was developed because of the impact of northeast snowstorms can have on the rest of the country in terms of transportation and economic impact.

Table 53 - NESIS Winter Storm Rankings

NESIS Winter Storm Rankings			
Category	**Description**	**NESIS Range**	**Definition**
1	Notable	1.0 – 2.49	These storms are notable for their large areas of 4-inch accumulations and small areas of 10-inch snowfall.
2	Significant	2.5 – 3.99	Includes storms that produce significant areas of greater than 10-inch snows while some include small areas of 20-inch snowfalls. A few cases may even include relatively small areas of very heavy snowfall accumulations (greater than 30 inches).
3	Major	4.0 – 5.99	This category encompasses the typical major Northeast snowstorm, with large areas of 10-inch snows (generally between 50 and 150 x 103 mi^2 – roughly one to three times the size of New York State with significant areas of 20-inch accumulations.

NESIS Winter Storm Rankings			
Category	**Description**	**NESIS Range**	**Definition**
4	Crippling	6.0 – 9.99	These storms consist of some of the most widespread, heavy snows of the sample and can be best described as crippling to the northeast U.S, with the impact to transportation and the economy felt throughout the United States. These storms encompass huge areas of 10-inch snowfalls, and each case is marked by large areas of 20-inch and greater snowfall.
5	Extreme	10+	The storms represent those with the most extreme snowfall distributions, blanketing large areas and populations with snowfalls greater than 10, 20, and 30 inches. These are only storms in which the 10-inch accumulations exceed 200 X 103 mi^2 and affect more than 60 million people.
Source: Kocin and Uccellini, 2004			

The climate of Maryland is marked by abundant snowfall. Winter weather can reach Maryland as early as October and is usually in full force by late November with average winter temperatures between 20- and 40-degrees Fahrenheit. Calvert County receives an average of about 5.4 inches of snowfall a year. Most areas of Calvert County experience the effects of winter storms frequently. The general indication of the average annual snowfall map shows areas that are subject to a consistent risk for large quantities of snow.

4.3.15.3 Past Occurrence

Figure 33 – Winter Storm Events by County in Maryland shows the number of winter storm events from 1950 – 2022 for the State of Maryland. Calvert County had twenty-five such events. *Table 54 – Recent Annual Snowfall Estimates* shows recent annual snowfall measurements as stated by NOAA. Overall, Calvert County has experienced a decrease of the annual estimated average of snowfall. On average, the annual snowfall totals have increased in the time periods from 2015-2016 to2021-2022. A list of additional Calvert County winter storms, and other related events is outlined in *Table 55 – Calvert County Winter Weather History*.

Table 54 - Recent Annual Snowfall Estimates

Recent Annual Snowfall Estimates	
Time Span	**Snowfall Estimates (inches)**
1999-2000	1.40
2000-2001	2.15
2001-2002	Data Unavailable
2002-2003	40.7

Recent Annual Snowfall Estimates	
Time Span	**Snowfall Estimates (inches)**
2003-2004	9.3
2004-2005	15.4
2005-2006	14.8
2006-2007	9.9
2007-2008	4.4
2008-2009	13
2009-2010	55.6
2010-2011	9
2011-2012	Data Unavailable
2012-2013	5.9
2013-2014	Data Unavailable
2014-2015	Data Unavailable
2015-2016	4.7
2016-2017	5.5
2017-2018	12.7
2018-2019	12.1
2019-2020	Data Unavailable
2020-2021	6.3
2021-2022	16.2
Source: NOAA, 2023	

Table 55 - Calvert County Winter Weather History

Calvert County Winter Weather History		
Location	**Date**	**Event Type**
Calvert (Zone)	01/07/1996	Blizzard
Calvert (Zone)	02/02/1996	Heavy Snow
Calvert (Zone)	02/03/1996	Heavy Snow
Calvert (Zone)	02/16/1996	Heavy Snow
Calvert (Zone)	01/09/1997	Winter Weather
Calvert (Zone)	02/08/1997	Heavy Snow
Calvert (Zone)	01/14/1999	Winter Weather
Calvert (Zone)	03/09/1999	Winter Storm
Calvert (Zone)	01/20/2000	Winter Storm
Calvert (Zone)	01/21/2000	Extreme Cold/Wind Chill
Calvert (Zone)	01/22/2000	Extreme Cold/Wind Chill
Calvert (Zone)	01/25/2000	Winter Storm
Calvert (Zone)	01/27/2000	Extreme Cold/Wind Chill
Calvert (Zone)	01/30/2000	Ice Storm
Calvert (Zone)	12/22/2000	Extreme Cold/Wind Chill
Calvert (Zone)	02/22/2001	Winter Storm

Calvert County Winter Weather History		
Location	**Date**	**Event Type**
Calvert (Zone)	04/19/2001	Extreme Cold/Wind Chill
Calvert (Zone)	01/03/2002	Winter Weather
Calvert (Zone)	01/19/2002	Winter Weather
Calvert (Zone)	02/06/2003	Winter Storm
Calvert (Zone)	02/14/2003	Winter Storm
Calvert (Zone)	02/26/2003	Winter Weather
Calvert (Zone)	12/04/2003	Winter Weather
Calvert (Zone)	12/14/2003	Winter Weather
Calvert (Zone)	01/17/2004	Winter Weather
Calvert (Zone)	01/25/2004	Winter Weather
Calvert (Zone)	02/24/2005	Winter Storm
Calvert (Zone)	12/06/2005	Heavy Snow
Calvert (Zone)	12/09/2005	Winter Weather
Calvert (Zone)	02/12/2006	Heavy Snow
Calvert (Zone)	02/12/2007	Winter Weather
Calvert (Zone)	02/24/2007	Winter Weather
Calvert (Zone)	04/06/2007	Winter Weather
Calvert (Zone)	01/17/2008	Winter Weather
Calvert (Zone)	02/20/2008	Winter Weather
Calvert (Zone)	02/22/2008	Winter Weather
Calvert (Zone)	01/27/2009	Winter Storm
Calvert (Zone)	03/01/2009	Winter Storm
Calvert (Zone)	12/05/2009	Winter Weather
Calvert (Zone)	12/18/2009	Winter Storm
Calvert (Zone)	01/07/2010	Winter Weather
Calvert (Zone)	01/30/2010	Winter Storm
Calvert (Zone)	02/02/2010	Winter Weather
Calvert (Zone)	02/05/2010	Winter Storm
Calvert (Zone)	02/06/2010	Blizzard
Calvert (Zone)	02/09/2010	Winter Storm
Calvert (Zone)	02/10/2010	Blizzard
Calvert (Zone)	12/16/2010	Winter Weather
Calvert (Zone)	12/25/2010	Winter Weather
Calvert (Zone)	01/11/2011	Winter Weather
Calvert (Zone)	01/17/2011	Winter Weather
Calvert (Zone)	01/26/2011	Winter Weather
Calvert (Zone)	01/31/2011	Winter Weather
Calvert (Zone)	02/01/2011	Winter Weather
Calvert (Zone)	03/27/2011	Winter Weather
Calvert (Zone)	01/20/2012	Winter Weather
Calvert (Zone)	01/22/2012	Winter Weather

Calvert County Winter Weather History		
Location	**Date**	**Event Type**
Calvert (Zone)	01/23/2013	Winter Weather
Calvert (Zone)	01/25/2013	Winter Weather
Calvert (Zone)	01/28/2013	Winter Weather
Calvert (Zone)	03/25/2013	Winter Weather
Calvert (Zone)	12/08/2013	Winter Weather
Calvert (Zone)	01/02/2014	Winter Weather
Calvert (Zone)	01/10/2014	Winter Weather
Calvert (Zone)	01/21/2014	Winter Weather
Calvert (Zone)	01/28/2014	Winter Weather
Calvert (Zone)	02/04/2014	Winter Weather
Calvert (Zone)	02/12/2014	Winter Weather
Calvert (Zone)	02/13/2014	Winter Weather
Calvert (Zone)	02/25/2014	Winter Weather
Calvert (Zone)	02/26/2014	Winter Weather
Calvert (Zone)	03/03/2014	Winter Storm
Calvert (Zone)	03/16/2014	Winter Storm
Calvert (Zone)	01/14/2015	Winter Weather
Calvert (Zone)	02/09/2015	Winter Weather
Calvert (Zone)	02/16/2015	Winter Storm
Calvert (Zone)	02/21/2015	Winter Weather
Calvert (Zone)	02/25/2015	Winter Weather
Calvert (Zone)	03/01/2015	Ice Storm
Calvert (Zone)	03/03/2015	Winter Weather
Calvert (Zone)	03/05/2015	Winter Storm
Calvert (Zone)	01/23/2016	Blizzard
Calvert (Zone)	02/14/2016	Winter Storm
Calvert (Zone)	03/03/2016	Winter Weather
Calvert (Zone)	12/17/2016	Winter Weather
Calvert (Zone)	01/07/2017	Winter Storm
Calvert (Zone)	01/30/2017	Winter Weather
Calvert (Zone)	03/13/2017	Winter Weather
Calvert (Zone)	12/08/2017	Winter Weather
Calvert (Zone)	01/03/2018	Winter Storm
Calvert (Zone)	02/07/2018	Winter Weather
Calvert (Zone)	03/20/2018	Winter Storm
Calvert (Zone)	12/09/2018	Winter Weather
Calvert (Zone)	01/12/2019	Winter Storm
Calvert (Zone)	02/20/2019	Winter Weather
Calvert (Zone)	01/31/2021	Winter Weather
Calvert (Zone)	02/07/2021	Winter Weather
Calvert (Zone)	02/11/2021	Winter Weather

Calvert County Winter Weather History		
Location	**Date**	**Event Type**
Calvert (Zone)	02/13/2021	Ice Storm
Calvert (Zone)	02/18/2021	Winter Storm
Calvert (Zone)	01/03/2022	Winter Storm
Calvert (Zone)	01/28/2022	Winter Weather
Source: NOAA NCEI, 2023		

4.3.15.4 Future Occurrence

Winter storm hazards in Maryland are guaranteed yearly since the state is located at a relatively high latitudes resulting in winter temperatures that range between 0- and 32-degrees Fahrenheit for a good deal of the fall through early spring season (later October until mid-April). In addition, the state is exposed to large quantities of moisture from both the Great Lakes and the Atlantic Ocean. While it is almost certain that a number of significant winter storms will occur during the winter and fall season, what is not easily determined is how many such storms will occur during that time frame. Based on historical snow related disaster declaration occurrences, the State of Maryland can expect a snowstorm of disaster declaration proportions, on average, once every three to five years. Similarly, for ice storms, based on historical disaster declarations, it is expected that on average, ice storms of disaster proportions will occur once every seven to ten years within the state.

Climate change could increase the intensity of winter storms in the northeastern United States and Calvert County, Maryland. With warmer air temperatures, more moisture will be held in the air, and if the temperatures on the ground are below freezing, this could result in more snow falling during a weather event like a winter storm. These events may become less frequent as the climate warms, but they could be more intense.

4.3.15.5 Vulnerability Assessment

Severe winter storms are of significant concern to Calvert County because of their frequency and magnitude in the region. Additionally, they are of significant concern due to the direct and indirect costs associated with these events; delays caused by the storms and impacts on the people and facilities of the region related to snow and ice removal, health problems, cascade effects such as utility failure and traffic accidents, and stress on community resources.

Every year, winter weather indirectly and deceptively kills hundreds of people in the United States, primarily from automobile accidents, over exertion, and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind driven snow, drifting snow, extreme cold temperatures, and dangerous wind chill. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. Heavy accumulations of ice can bring down trees and powerlines, disabling electrical power and communications for days or weeks. Heavy snow can immobilize a region and paralyze a city, shutting down all air and rail transportation and disrupting medical and emergency services. The economic impact of winter weather each year is quite large, with costs for snow removal, damage, and loss of business in the millions each year. Heavy snow can immobilize and strand commuters as well as stopping the flow of supplies through an area or transportation corridor. In rural areas, homes and farms may be isolated for days and unprotected livestock may be lost. Bridge and overpasses are particularly dangerous because they freeze before other transportation surfaces. For the purposes of this Hazard Mitigation Plan, the entire population of Calvert County (94,573) is exposed to severe winter storm events. The elderly are considered the most susceptible to this hazard due to their increased risk of injury and death from falls, overexertion, and or attempts to clear ice and snow. The elderly population is also more vulnerable to utility outages in winter, especially when they are paired with winter storm events. *Table 57 – Utility Outages in Calvert County in Winter* shows the number of power outages, phone outages, and 911 outages, that have occurred in the county during winter months. Vulnerable populations within Calvert County may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). The unsheltered populations of an area are at most risk to winter storm events.

The table below illustrates the number of citizens per municipality under the age of five or over the age of sixty-five years of age who are at an increased vulnerability to winter storms, and cascading hazards from winter storms:

Table 56 - Population per Municipality under 5 Years or 65 Years or Older

Population per Municipality under 5 Years or 65 Years or Older				
Municipality	**Number of People under 5 years of age**	**Percent of Population**	**Number of People 65 years or older**	**Percent of Population**
Chesapeake Beach	319	5.1%	1,104	17.5%
North Beach	109	4.2	351	13.4%
Calvert County	4,772	5.2%	13,870	15.0%
Source: United States Census Bureau (USCB), American Community Survey (ACS), 2021				

Approximately 5.2% of the total population of Calvert County is under the age of five years old and approximately 15.0% of the total population is sixty-years old or older. In total, 20.2% of the population is at an increased risk from exposure to winter storm events and cascading hazards.

Table 57 - Utility Outages in Calvert County in Winter

Utility Outages in Calvert County in Winter		
Location	**Date**	**Event**
Calvert County	12/23/2022	Power Outage
Source: Calvert County, 2023		

The entire general building stock inventory in Calvert County is exposed and vulnerable to the severe winter storm hazard. In general, structural impacts include damage to roof and building frames, rather than building content. There was no historical information available that identified property damages within Calvert County due to a single severe winter storm event. Current modeling tools are not available to estimate specific losses for this hazard. A specific area that is vulnerable to the severe winter storm hazard is the floodplain. At risk general building stock and infrastructure in floodplains are presented in the flood profile due to snow and ice melt. Generally, losses from flooding associated with severe winter storms should be less than that associated with a 100-year or 500-year flood.

Full functionality of critical facilities such as police, fire, and medical facilities is essential for response during and after a severe winter storm event. These critical facility structures are largely constructed of concrete and masonry; therefore, they should only suffer minimal structural damage from severe winter storm events. Backup power is recommended critical infrastructure and facilities due to the potential for power interruption. Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. Severe snowfall requires infrastructure to clear roadways and alert citizens to dangerous conditions. In spring, this type of roadway damage must be repaired. Additionally, freezing rain and ice storms impact utilities (i.e., power lines and overhead utility wires) causing power outages for hundreds to thousands of residents.

The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain local financial resources. However, because severe winter storms are a regular occurrence in this area, Calvert County is generally well-prepared for snow and ice removal each season.

Winter storm vulnerability is going to increase in Calvert County when climate change is considered. As mentioned above in Section 4.3.15.4, climate change is expected to increase the intensity of winter storms. With warmer air temperatures, more moisture will be held in the air, and if temperatures on the ground rapidly decrease, or fall below freezing, this could result in more snow falling during a weather event like a winter storm. These events may become less frequent as the global temperatures increase, but they could become more intense.

As seen in *Table 2 – Population Change in Calvert County*, the Town of Chesapeake Beach and the Town of North Beach have seen a net population increase from the 2010 decennial census to the 2020 decennial census. The impact that a winter storm can have on these municipalities will vary. Municipalities with an increase in population could have more resources available as well as personnel to mitigate the impacts that a winter storm can bring to one's community. A municipality that experienced a population decrease may not have these resources or personnel at their expense to prepare for and mitigate against an impending winter storm. Adversely, municipalities with an increase in population could experience a more significant impact simply because they have more individuals being impacted compared to a smaller municipality. All municipalities within Calvert County are at the same level or risk to winter storms, but the direct and indirect impacts and vulnerability will vary by municipality.

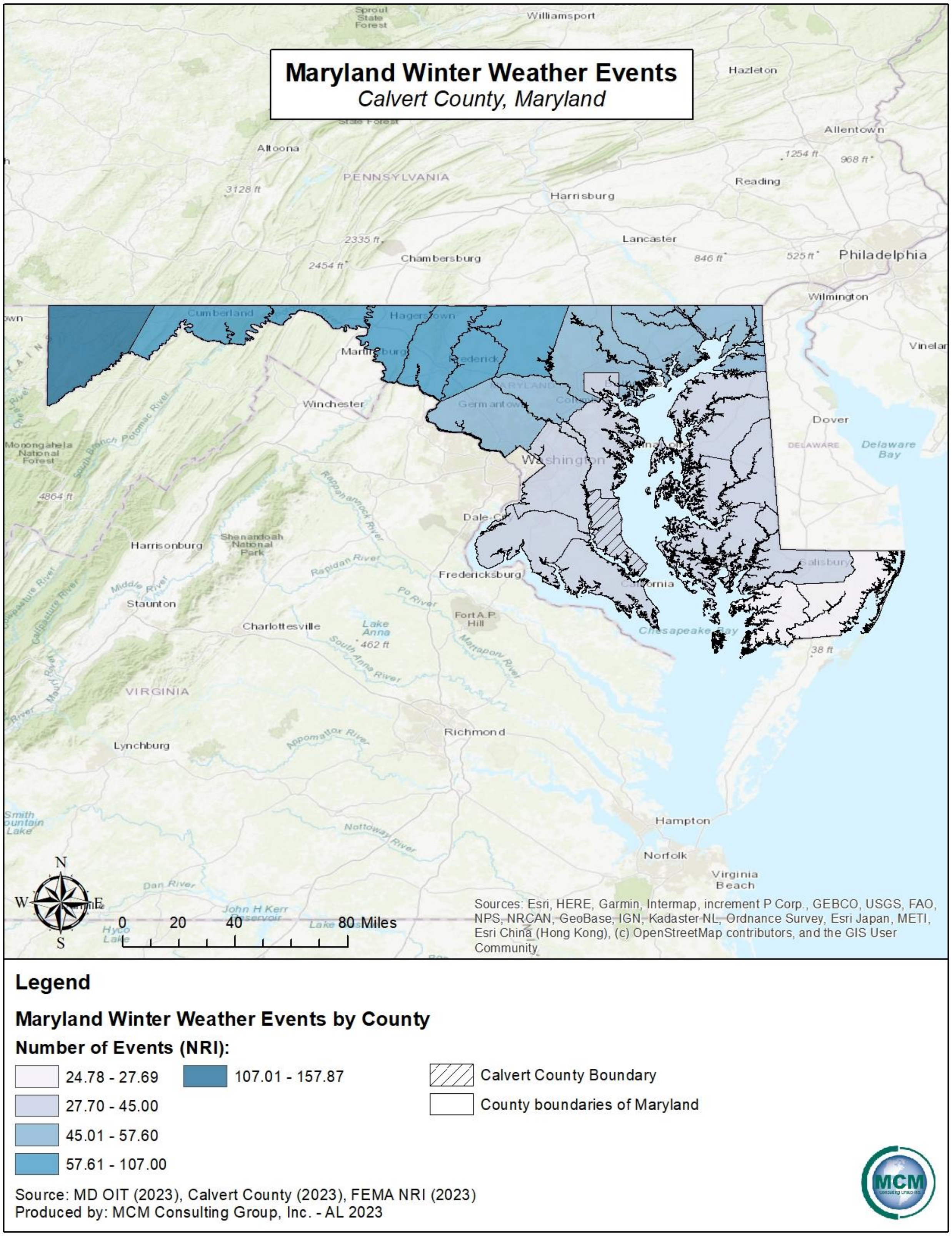
Vulnerable, or underserved, populations within Calvert County may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). The unsheltered populations of an area are at the highest vulnerability of winter storm events. Individuals who are also in poverty, based on information provided in the United States Census are more likely to have issues meeting economic requirements for utility bills in the winter as well. All of these populations can be considered socially vulnerable or communities that have unmet needs.

Land use and major developments will have negligible impacts on the vulnerability of Calvert County to winter storm events. Land use may impact the response capabilities of Calvert County in a winter storm event, but changes in that land use will not increase the vulnerability. Calvert County has significant capabilities to respond to winter storm events. Major development in the county will need to be planned to allow for winter storm response, including size and make up of transportation routes, and location of snow removal areas.

Impact of winter storms on historic properties in Calvert County

All of the historic properties that are located in Calvert County are at an increased vulnerability to winter storm events. Winter storms impacting Calvert County are often regional in nature and impact a large area. With that in mind, all of the properties could be impacted differently, but also significantly.

Figure 33 - Winter Storm Events by County in Maryland



4.3.16. Civil Disturbance

4.3.16.1 Location and Extent

Civil disturbance refers to mass acts of disobedience where participants can become hostile to authority and there is a threat to maintaining public safety and order. Such disturbances can often be forms of protest in the face of socio-political problems. Riots have not been frequent occurrences throughout the history of the State of Maryland, however when they occur, they can cause significant property damage, injury and even loss of life. The scale and scope of civil disturbance events varies widely. Government facilities, local landmarks, prisons, and universities are common sites where crowds and mobs may gather.

Criminal activity refers to all criminality, including enemy attack, sabotage, physical or information break of security, workplace or school violence, harassment, discrimination, and other crimes. Criminal activity is a very broad hazard category and similar to civil disturbance, the scale and scope of incidents or events vary widely.

4.3.16.2 Range of Magnitude

Civil disturbances can take the form of small gatherings or large groups blocking or impeding access to a building or disrupting normal activities by generating noise and intimidating people. They can range from a peaceful sit-in to a full-scale riot, in which a mob burns or otherwise destroys property and terrorizes individuals. Even in its more passive forms, a group that blocks roadways, sidewalks, or buildings interferes with public order. There are two types of large gatherings typically associated with civil disturbances: a crowd and a mob. A crowd may be defined as a casual, temporary collection of people without a strong, cohesive relationship. Crowds can be classified into four categories:

Casual Crowd: A casual crowd is merely a group of people who happen to be in the same place at the same time. Violent conduct does not occur.

Cohesive Crowd: A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity, such as worshipping, dancing, or watching a sporting event. Although they may have intense internal discipline, they require substantial provocation to arouse to action.

Expressive Crowd: An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are assembled as an expression of common sentiment or frustration. Members wish to be seen as a formidable influence. One of the best examples of this type is a group assembled to protest.

Aggressive Crowd: An aggressive crowd is comprised of individuals who have assembled for a specific purpose. This crowd often has leaders who attempt to arouse the members or motivate them to action. Members are noisy and threatening and will taunt authorities. They may be more impulsive and emotional and require only minimal stimulation to arouse violence. Examples of this type of crowd could include demonstrators and strikers, though not all demonstrators and strikers are aggressive.

A mob can be defined as a large disorderly crowd or throng. Mobs are usually emotional, loud, tumultuous, violent, and lawless. Similar to crowds, mobs have different levels of commitment and can be classified into four categories:

Aggressive Mob: An aggressive mob is one that attacks, riots, and terrorizes. The object of violence may be a person, property, or both. An aggressive mob is distinguished from an aggressive crowd only by lawless activity. Examples of aggressive mobs are the inmate mobs in prisons and jails, mobs that act out their frustrations after political defeat, or violent mobs at political protests or rallies.

Escape Mob: An escape mob are those groups which attempt to flee from something such as a fire, bomb, flood, or other catastrophe. Members of escape mobs are generally difficult to control and can be characterized by unreasonable terror.

Acquisitive Mob: An acquisitive mob is one motivated by a desire to acquire something. Riots caused by other factors often turn into looting sprees. This mob exploits a lack of control by authorities in safeguarding property.

Expressive Mob: An expressive mob is one that expresses fervor or revelry following some sporting event, religious activity, or celebration. Members experience a release of pent-up emotions in highly charged situations.

In the event of a significant civil disturbance or criminal activity incident, local government operations and the delivery of services in the community may experience short-term disruptions. The greatest secondary effect is the impact on the economic and financial conditions of the affected community, particularly in relation to the property, facilities, and infrastructure damaged as a result of the disturbance. More serious acts of vandalism may result in limited power failure or hazardous material spills, leading to a possible public health emergency. Altered traffic patterns may increase the probability of a transportation accident.

Calvert County 's greatest likelihood for civil disturbance is in Prince Frederick which is the county seat. Citizens, property, and infrastructure could be affected if a large-scale disorder were to take place. Typically, government facilities, landmarks, prisons, and universities are common sites where crowds or mobs may gather. Calvert County is home to two universities and post-secondary education centers, including the College of Southern Maryland and the University of Maryland.

4.3.16.3 Past Occurrence

The county has not experienced any *significant* civil disturbance events.

Following the death of African-American George Floyd in Minneapolis, Minnesota in May 2020 at the hands of law enforcement, civil unrest erupted across the nation. Calvert County experienced a peaceful protest to the George Floyd Black Lives Matter movement on June 11th,

2020. Over 100 peaceful protesters marched the streets to chant "no justice no peace". During this peaceful protest no one got hurt and no damage was recorded for Calvert County.

Calvert County has a Detention Center with a 172-bed capacity. Being there is one detention center in Calvert County it still leaves the potential for a riot within the facility.

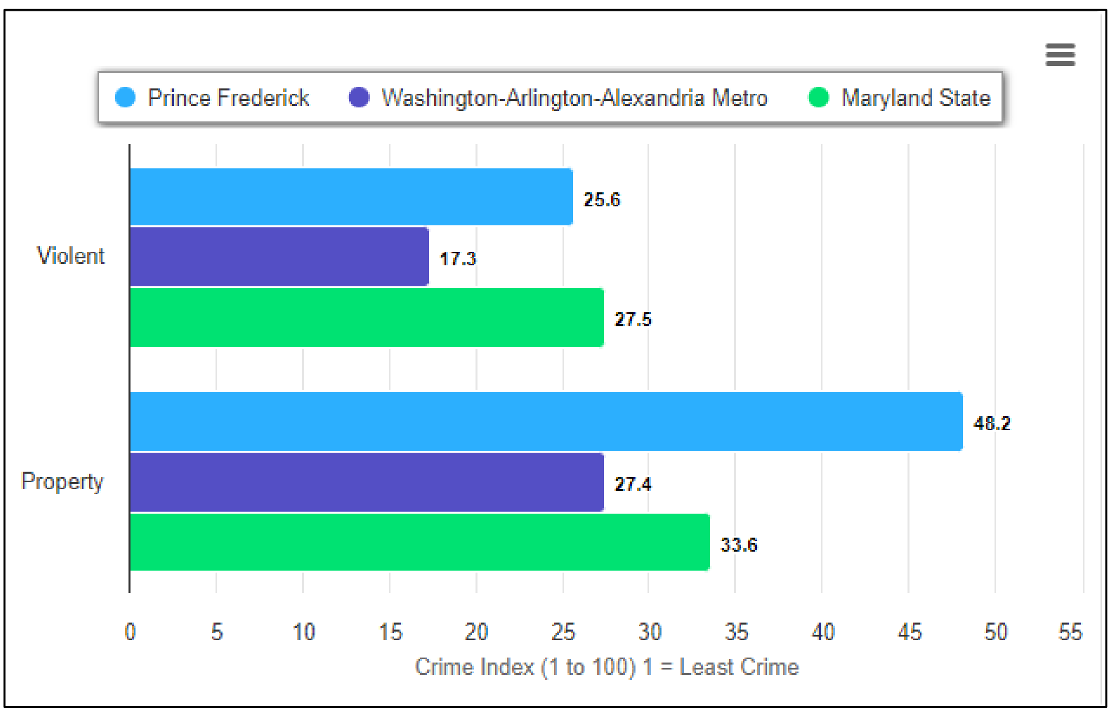
4.3.16.4 Future Occurrence

While unlikely, civil disturbances may occur in Calvert County, and it is difficult to accurately predict the probability of future occurrence for civil disturbance events over the long-term.

According to the Maryland State Hazard Mitigation Plan, from 2012 to 2018, the state experienced an average of fifty-five civil disturbance events each year. While that number is relatively low and the occurrences in Calvert County are rare, the local planning team (LPT) decided civil disturbance should be regarded as a high-risk hazard due to the current political trends and frictions across the country.

Like civil disturbance, it is extremely difficult to predict when criminal activity may take place in Calvert County and throughout the State of Maryland. According to the City-Data.com crime index, the 2021 crime rate in Prince Frederick (the county's highest population center) is 12.9% times greater than the U.S. average. In the last five years, Prince Frederick has seen a rise in violent crime and decreasing property crime, this can be seen in *Figure 34 – City-Data.com Crime Index*.

Figure 34 - City-Data.com Crime Index



4.3.16.5 Vulnerability Assessment

All municipalities in Calvert County can be vulnerable to civil disturbance and criminal activity; however. the anticipated impact from such events is minimal. These events may be sparked for varying reasons and the seriousness of the event may well be exacerbated by how authorities handle the crowd. At the writing of this plan, the political temperature of the country as a whole continues to run high, making this hazard vulnerability one for consistent monitoring by public safety officials.

4.3.17. Dam Failure

4.3.17.1 Location and Extent

A dam restricts the flow of water or underground streams and often creates reservoirs for water storage. The reservoirs created by these barriers not only suppress floods but also provide water for activities such as irrigation, human consumption, industrial use aquaculture, and navigability.

Dam failures occur usually as a secondary effect of massive amounts of rainfall and flooding, causing too much water to enter the spillway system. This type of failure occurs with little to no warning. Spring thaws, severe thunderstorms, and heavy rainfall are also contributing factors to potential dam failures. Depending on the size of the body of water where the dam is constructed, additional water may come from distant upstream locations. Water contributions may also come from dam failures in adjoining counties that are along the same riverine or water features.

FEMA considers the following to be the most frequent causes of dam failures:

- Overtopping caused by floods that exceed the capacity of the dam
- Deliberate acts of sabotage
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate maintenance and upkeep

Poor engineering or poor maintenance may also cause dam failure. The Maryland Department of the Environment (MDE) issues permits for dams after technical reviews. The local dam owners are primarily responsible in the state of Maryland for inspections. Inspection results are characterized as either safe or unsafe.

The National Inventory of Dams (NID) is a registry that captures information about structures that are greater than or equal to 25 feet in height or impound 50-acre-feet or more of water (an acre-foot is equal to 325,851 gallons of water); it includes structures above 6 feet in height where failure would potentially cause damage downstream. The dams are classified in terms of hazard potential as “High”, “Significant”, or “Low”, with high-hazard and significant-hazard dams requiring emergency action plans (EAPS) There are two high-hazard and six low-hazard dams in Calvert County that are both publicly and privately owned and have been reported to the Maryland Department of the Environment. There are also ten dams with a hazard classification as significant. There are two dams within the county that are high-hazard and require an emergency action plan. The state of Maryland also lists small ponds in the inventory for dams in Calvert County that are also possible to cause a hazard if certain events and changes occur. *Table 59 – Calvert County Dam Inventory* illustrates the dams located in Calvert County. *Table 58 – High-Hazard Dams Municipality Summary* summarizes the high-hazard dams in Calvert County by municipality or Town Center. The municipalities not listed do not have high-hazard dams. *Table 60 – Dam Name and Purpose* lists the dams located in Calvert County and their purpose code, and the description of purpose based on the Maryland codes.

Table 58 - High-Hazard Dams Municipality Summary

High-Hazard Dams – Municipal Summary	
Municipality/Town Center	**Number of High-Hazard Dams**
Lusby	1
Sunderland	1
Total:	**2**

Table 59 - Calvert County Dam Inventory

Calvert County Dams							
Dam Name	**River**	**Owner Name**	**Year Completed**	**Dam Height (feet)**	**Drainage Area (acres)**	**Hazard**	**EAP**
Calvert Gateway	Hall Creek	Village Ltd Partnership	2000	16	25.6	Significant	Yes
Chesapeake Ranch Estates Dam	Mill Creek	Chesapeake Ranch Estates	1965	46	1856	High	Yes
Cove Point Lng Main Dam	Wilbur Creek	BHE GT&S A Berkshire Hathaway Energy Company	1974	74	128	Significant	Yes
Cove Point Lng Secondary Dam	Wilbur Creek	BHE GT&S A Berkshire Hathaway Energy Company	1974	38	128	Significant	Yes
Ferry Landing Woods Pond	Patuxent River	Ferry Landing Woods Civic Association	1981	22	128	Low	No
Lake Karylbrook Community Pond (Keren Drive)	Fishing Creek	Calvert County Department of Public Works	1990	30	160	Significant	Yes

Calvert County Dams							
Dam Name	**River**	**Owner Name**	**Year Completed**	**Dam Height (feet)**	**Drainage Area (acres)**	**Hazard**	**EAP**
Lake Ridge Community Pond Dam (Alta Drive)	Fishing Creek	Lake Ridge Homeowners Association, Inc	1969	28	192	Significant	Yes
Prince Frederick Wwtp Pond Two	Parker Creek	Calvert Department of Public Works	2002	65	64	Low	No
Queensberry Drive Playground Dam	Hunting Creek	Queensberry Community Association, Inc.	1981	28	172.8	Significant	Yes
Queensberry Drive Swim Pond	Hunting Creek	Queensberry Community Association, Inc.	2001	19	76.8	Significant	Yes
Running Hare Vineyard Lake	Battle Creek	Running Hare Vineyard	1970	20	320	Low	No
Shores of Calvert Lower Dam	Patuxent River	Shores of Calvert Assn	1972	15	64	Low	No
Shores of Calvert Upper Dam	Patuxent River	Shores of Calvert Assn	1972	25	211.2	Significant	Yes
Starkey Pond	Morsell Creek	Tom Starkey	1950	11	192	Low	No
Stoneleigh Community Pond	Cocktown Creek	Calvert County Department of Public Works	1978	24	64	Significant	Yes
Sunderland Railroad	Fishing Creek	John Ireland	1850	25	128	Low	No

Calvert County Dams							
Dam Name	**River**	**Owner Name**	**Year Completed**	**Dam Height (feet)**	**Drainage Area (acres)**	**Hazard**	**EAP**
Embankment Pond							
Twin Lakes Upper Pond	Cocktown Creek	Twin Lakes Community Association, Inc.	1970	15	38.4	Significant	Yes
Victoria Station Community Lake	Graham Creek	Victoria Station Homeowners Association	1986	27	192	High	Yes
Source: NID, 2023							

Table 60 - Dam Name and Purpose

Calvert County Dams and Purposes (NID 2023)		
Dam Name	**Purpose Code**	**Purpose Code Description**
Chesapeake Ranch Estates Dam	C	Flood Risk Reduction
Calvert Gateway	R	Recreation
Cove Point Lng Main Dam	R/T	Recreation/ Tailings
Cove Point Lng Secondary Dam	T	Tailings
Ferry Landing Woods Pond	R	Recreation
Lake Karylbrook Community Pond	R	Recreation
Lake Ridge Community Pond Dam	I	Irrigation
Prince Frederick Wwtp Pond 2	P	Other
Queensberry Drive Playground Dam	C	Flood Risk Reduction
Queensberry Drive Swm Pond	C	Flood Risk Reduction
Running Hare Vineyard Lake	R	Recreation
Shores of Calvert Lower Dam	R	Recreation
Shores of Calvert Upper Dam	R	Recreation
Starkey Pond	P	Other
Stoneleigh Community Pond	R	Recreation
Sunderland Railroad Embankment Pond	R	Recreation
Twin Lakes Upper Pond	R	Recreation

Calvert County Dams and Purposes (NID 2023)		
Dam Name	**Purpose Code**	**Purpose Code Description**
Victoria Station Community Lake	C	Flood Risk Reduction
Source: NID, 2023		

The Maryland Department of the Environment defines a high-hazard dam as a dam that "Failure would likely result in loss of human life, extensive property damage to homes and other structures, or cause flooding of major highways such as state roads or interstates." High-hazard dams are inspected every year by MDE's Dam Safety Division, significant hazard dams are inspected every three years, and low hazard dams are inspected every five to seven years. (MDE).

4.3.17.2 Range of Magnitude

Dam failures can pose a serious threat to communities located downstream from any dam, but most significantly, major dams. The impact of a dam failure is dependent on the volume of water impounded by the dam and the amount of population or assets located downstream. Catastrophic failures are characterized by the sudden, rapid, and uncontrolled release of impounded water from a dammed impoundment or water body. *Figure 35 – Calvert County Dams* shows the location of dams within Calvert County as well as their hazard designation.

4.3.17.3 Past Occurrence

There has been one past occurrence of near dam failure or major incidence occurring at the locations of dams within Calvert County. The Running Hare Vineyard Dam in Calvert County nearly failed during Tropical Storm Isaias. Smaller incidents have occurred but have not had significant impacts in the county.

There have been a few historically destructive dam failures in Maryland over the course of the past two hundred years. There have been forty-five near dam failures or dam failures in Maryland between the years 1930 to 2021 (Maryland HMP, 2021).

4.3.17.4 Future Occurrence

Although dam failures can occur at any time, given the right circumstances, the likelihood of a dam failure in Calvert County is considered to be moderate.

The presence of structural integrity and inspection programs significantly reduces the potential for major dam failure events to occur.

The construction, operation, maintenance, and abandonment of dams is reviewed and monitored by the MDE Dam Safety Program. Dams are evaluated based on those categories such as slope stability, undermining seepage, and spillway adequacy. With more strict construction and design procedures in place, the future occurrence of a dam failure is increasingly small. Newly constructed dams are thoroughly examined by professional engineers to prevent future dam failure events.

4.3.17.5 Vulnerability Assessment

Property and populations located downstream from any dams are vulnerable to dam failures. Maryland hazard classification for dams follows similar methods as that of the Federal Emergency Management Agency. Maryland classifies a dam as having either a high, low, or significant class. The Code of Maryland Regulations (COMAR 26.17.04.05) breakdown by dam classification and number of dams in Maryland can be found in *Table 61 – Dam Classification*.

Table 61 - Dam Classification

Dam Classification			
Dam Size Classification			
Hazard Class	**Category**	**Description**	**Number of Dams in Maryland**
High	I	Failure would likely result in loss of human life, extensive property damage to homes and other structures, or cause flooding of major highways such as State roads or interstates. High Hazard dams are referred to as "Category I" dams in the Code of Maryland Regulations (COMAR 26.17.04.05) and "Class C" ponds by the US Natural Resources Conservation Service (NRCS).	81
Significant	II	Failure could possibly result in loss of life or increase flood risks to roads and buildings, with no more than 2 hours impacted and less than six lives in jeopardy. These are referred to as "Category II" dams in COMAR and "Class B" by NRCS.	114
Low	III	Failure is unlikely to result in loss of life and only minor increase to existing flood levels at roads and buildings is expected. These structures are referred to as "Category III" dams in COMAR and "Class A" by NRCS.	240
Source: State of Maryland, Maryland Department of the Environment, COMAR 26.17.04.05			

Dam failures can cause significant environmental effects, as the resulting flood from a dam failure is likely to disperse debris and hazardous materials downstream that can damage local ecosystems. Debris carried downstream can block roads, cause traffic accidents, disrupt traffic patterns, and delay the delivery of essential services along major traffic corridors. Debris flow can also cause landslides along steep slopes and embankments with low slope stability. The economic and financial impact from damage and recovery ranges from minimal to severe, depending on the magnitude of damage and scale of failure event.

Emergency action plans are developed by the owners of high-hazard and significant-hazard dams. These plans are then disseminated to first responders and other planning partners within the county. Vulnerable populations are those residents and businesses located downstream from a high-hazard dam within the inundation area. The emergency action plan identifies a call list to notify downstream at-risk populations. Emergency action plan exercises are held every five based on state regulations.

The characteristics of the two high-hazard dams in Calvert County vary greatly. The Shores of Calvert Upper Dam, located in Dunkirk, has the largest drainage area with a total of 211.2 acres. The dams that were constructed most recently are the Prince Frederick Wastewater Treatment Plant Pond Two, and Queensberry Drive Swim Pond, located in Prince Frederick, which was constructed in 2002, and the Queensberry Drive Swim Pond in Prince Frederick, which were constructed in 2001. The dam that is the oldest in the county is Sunderland Railroad Embankment Pond, which was constructed in 1850. The Cove point Long Main Dam is the tallest in the county with a height of seventy-four feet. Calvert County Department of Public Works owns the most dams in Calvert County with a total of three. These dams are the Lake Karylbrook Community Pond, Prince Frederick Wastewater Pond Two and Stoneleigh Community Pond. The dams in Calvert County are owned by a mix of public and private owners and vary in almost every aspect. The county dams are distributed relatively evenly throughout the county and municipalities, with an even mix of high and low hazard dams in the municipalities.

The failure or partial failure of a High-Hazard Potential Dam can have impacts that affect many different jurisdictions across Calvert County and counties adjacent to Calvert County. A failure at any of the dams in Calvert County would result in some inundation in at least those municipalities adjacent to the dam in question. A more comprehensive examination of risk inundation areas from High-Hazard Potential Dams can be conducted in future iterations of the Calvert County Hazard Mitigation Plan. This dataset was not readily accessible at the time of this writing. However, each of this municipalities that could be affected by the failure of a High-Hazard Potential Dam could result in the inundation of police stations and fire departments, critical infrastructure facilities, and community lifeline locations like medical facilities, power and energy facilities, and schools, nursing homes, and senior care and long term care facilities.

Calvert County is at risk when high-hazard potential dams are considered. There are three types of risk related to high-hazard potential dams and they are listed below:

Table 62 - High-Hazard Potential Dams Risk Type

High-Hazard Potential Dams Risk Types	
Type of Risk	**Description**
Incremental Risk	The risk (likelihood and consequences) to the pool area and downstream floodplain occupants that can be attributed to the presence of the dam should the dam breach prior or subsequent to overtopping, or undergo component malfunction or mis-operation, where the consequences considered are over and above those that would occur without dam breach. The consequences typically are due to downstream inundation, but loss of the pool can result in significant consequences in the pool area upstream of the dam.
Non-Breach Risk	The risk in the reservoir pool area and affected downstream floodplain due to 'normal' dam operation of the dam (e.g., large spillway flows within the design capacity that exceed channel capacity) or 'overtopping of the dam without breaching' scenarios.
Residual Risk	The risk that remains after all mitigation actions and risk reduction actions have been completed. With respect to dams, FEMA defines residual risk as "risk remaining at any time" (FEMA, 2015, p A-2). It is the risk that remains after decisions related to a specific dam safety issue are made and prudent actions have been taken to address the risk. It is the remote risk associated with a condition that was judged to not be a credible dam safety issue.
Source: "Rehabilitation of High Hazard Potential Dams Grant Program Guidance," June 2020	

At this time, insufficient information is available to conduct a substantive analysis of incremental, non-breach and residual risk relative to Calvert County's high hazard potential dams. However, it is acknowledged that incremental risk is "the risk (likelihood and consequences) to the pool area and downstream floodplain occupants that can be attributed to the presence of the dam should the dam breach prior or subsequent to overtopping, or undergo component malfunction or mis-operation, where the consequences considered are over and above those that would occur without dam breach;" non-breach risk is "the risk in the reservoir pool area and affected downstream floodplain due to 'normal' dam operation of the dam (e.g., large spillway flows within the design capacity that exceed channel capacity) or 'overtopping of the dam without breaching' scenarios;" and residual risk) is "the risk that remains after decisions related to a specific dam safety issue are made and prudent actions have been taken to address the risk. It is the remote risk associated with a condition that was judged to not be a credible dam safety issue" (FEMA, 2020 Rehabilitation of High Hazard Potential Dams Grant Program Guidance)

The risk of high-hazard potential dams in Calvert County is present but at the time of this writing, there is insufficient data to identify in exact detail the vulnerable populations and assets in inundation areas for the high-hazard potential dams. The areas downstream from the high-hazard potential dams are more vulnerable to inundation than areas that are upstream from said dams. There are current datasets to address high-hazard potential dam impacts in greater detail, but these datasets are still in development from the United States Army Corp of Engineers and the Federal Emergency Management Agency. Once these datasets have been published and inundation data is easier to acquire, this information will be used to develop more details risk assessment and vulnerability assessments for dam failure at the high-hazard potential dams.

Although there are data limitations to take into account in regard to high hazard potential dams in Calvert County, some open source, nationally available data can be integrated into this vulnerability assessment. One of those tools is the Resilience Analysis and Planning Tool (RAPT) administered by FEMA. This tool can overlay areas of interest around certain features to determine what types of populations are within certain distances of those features. In the table below, a 2-mile distance was calculated around each high-hazard dam in Calvert County. Those locations were then used to determine how many people or households are vulnerable to a dam failure based strictly on distance. Some of the indicators used for this analysis were total population, households without vehicles, households with limited English, and housing units that are mobile homes.

High-Hazard Dam Vulnerability Data				
Dam	**Total Population**	**Households without a vehicle**	**Households with limited English**	**Housing units that are mobile homes**
Chesapeake Ranch Estates Dam (Chisolm Trail)	14,201	337	38	86
Victoria Station Community Lake	4,010	173	4	8
Total	**18,211**	**510**	**42**	**94**
Source: RAPT, ACS, 2017-2021, Table B08201, Table S1602, and Table DP04				

An analysis was also conducted for high priority infrastructure within 2-miles of high-hazard dams in Calvert County. The information in the table below illustrates which infrastructure was located in that vulnerability zone.

High-Hazard Dam Vulnerability Data – Infrastructure				
Dam	**Hospitals**	**Nursing Homes**	**Fire Stations**	**Public Schools**
Chesapeake Ranch Estates	0	2	1	4

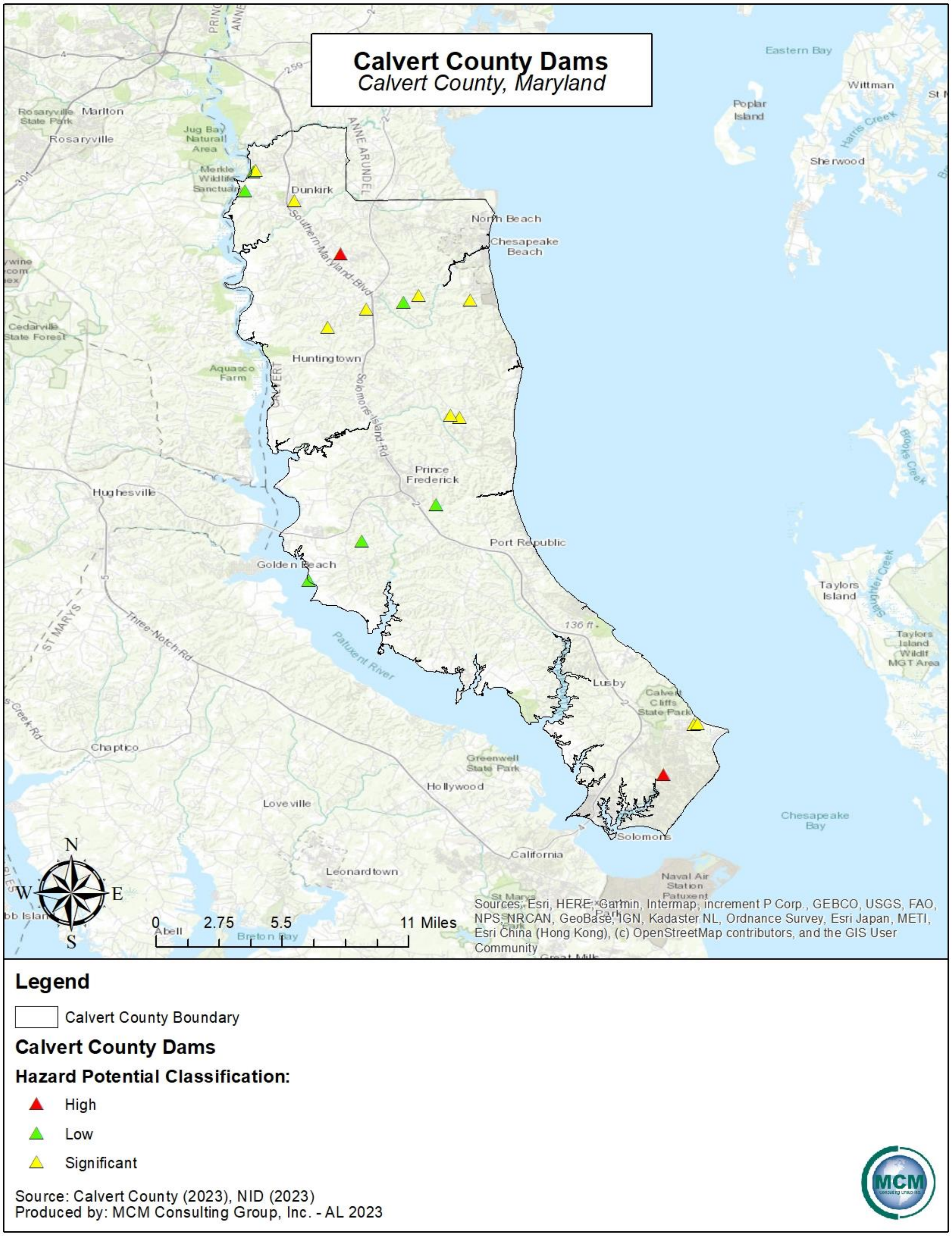
High-Hazard Dam Vulnerability Data – Infrastructure				
Dam	**Hospitals**	**Nursing Homes**	**Fire Stations**	**Public Schools**
Dam (Chisolm Trail)				
Victoria Station Community Lake	0	1	0	4
Source: RAPT, Homeland Infrastructure Foundation-Level Data, 2024				

The table below provides more information on infrastructure within 2 miles of high-hazard dams.

High-Hazard Dam Vulnerability Data – Infrastructure Names	
Dam	**Infrastructure Details**
Chesapeake Ranch Estates Dam (Chisolm Trail)	Two Nursing Homes: 1. Hermitage at St. John's Creek 2. Solomons Nursing and Rehab Center One Fire Station: 1. Solomons Volunteer Rescue Squad and Fire Department Four Public Schools: 1. Patuxent High School 2. Mill Creek Middle School 3. Patuxent Appeal Elementary School 4. Dowell Elementary School
Victoria Station Community Lake	One Nursing Home: 1. Caribbean Breeze Assisted Living III Four Public Schools: 1. Northern High School 2. Northern Middle School 3. Mount Harmony Elementary School 4. Sunderland Elementary School
Source: RAPT, Homeland Infrastructure Foundation-Level Data, 2024	

Future failures of a high-hazard potential dam in Calvert County could be a secondary impact or a cascading hazard from larger events such as large storms, including hurricanes and tropical depressions, seismic events, and landslide/soil movement events. With hurricanes and tropical storms impacting Calvert County on a regular basis, this is the largest vulnerability when cascading hazards are considered. The potential economic and socioeconomic impact from a high-hazard potential dam failure in Calvert County, or the surrounding counties would be catastrophic. Although specific information is difficult to present due to security of inundation data, large sections of commercial and industrial facilities will be impacted by water from a failure. This would also include population centers in Calvert County, including the Town Centers and the Towns of Chesapeake Beach and North Beach. Limitations for addressing these items is included in the narrative above.

Figure 35 - Calvert County Dams



4.3.18. Emergency Services

4.3.18.1 Location and Extent

Fire, emergency medical services (EMS), local emergency management coordinators (LEMC), and law enforcement service agencies are defined per municipality in Calvert County. In addition to the local services, the county hosts numerous special teams. Regional and state-wide services are also available.

With the exception of law enforcement, most areas are served by volunteers instead of career personnel, which increases response time due to volunteer availability. Volunteers provide emergency services above separately from their regular careers. Often agencies struggle with the availability of skilled personnel and resources at certain times of the day. The number of responders in general has decreased, in part due to issues including funding and retention of personnel.

Additionally, the time and expense obligations of required training are a factor in the decrease in number of responders. The initial training time for fire, EMS, and law enforcement can take several months to complete. Emergency medical services, requires a regular schedule of continued education to maintain certification. In the fire service, after the initial training, there are specialty courses offered, which are recommended, but not required. For law enforcement, skills such as firearms proficiency must be maintained, and updates to new laws and regulations continues throughout the officer's career.

4.3.18.2 Range of Magnitude

Finances, changing political climates, leadership, or a significant high-profile event can trigger a system to be declared as "success" or "failure". In some cases, a combination of these factors can create a perfect storm. Unfortunately, many "failed" systems are measured by recent events, no matter how successful they may have been in the past. Although financial problems are often blamed on poor leadership, they may have many root causes. Labor rates, benefits, poor productivity, operational design, insurance reimbursements, and market regulation all have a significant direct impact on the financial viability of an organization.

Two fundamental, yet misunderstood, topics are the financial and economic variables that drive emergency service systems. These systems typically generate revenue through tax subsidies, memberships, direct sales, diversification into other lines of business, grants, or fundraising. They spend most of these revenues on direct and indirect labor, and benefits. The remaining dollars go into infrastructure, fuel, medical supplies, insurances, fleet maintenance, dispatch, and other essential items, with hopefully, some left over for recapitalization or fund balance development. The range of the issues related to emergency service shortages are felt across the entire United States of America and the State of Maryland. Calvert County has felt emergency shortages and these shortages have had adverse effects on emergency response in the county.

4.3.18.3 Past Occurrence

There have been no official records kept on shortages to emergency services. However, there has been a decrease in the number of new volunteers in the fire service for several years. Most agencies are private organizations that lack local funding and exist based on tax dollars, fund raising, and donations received from their community. The need for fund raising adds to availability issues of volunteers. Most services past practices are not sustaining the current needs for funding and manpower. Without financial support from the communities, services may not be able to remain in operation to serve those same communities. Recruitment and personnel retention are a key to success.

Calvert County has had multiple events that were caused by emergency service shortages, most significantly from 2020 to 2022, exacerbated by the COVID-19 pandemic. Calvert County has experienced a major shortage of the emergency services personnel within the last five years. However, this shortage has not been caused exclusively by the COVID-19 pandemic and was occurring before the pandemic across Calvert County and the State of Maryland.

4.3.18.4 Future Occurrence

Historically, it has been difficult for small communities to have a paid fire or EMS service, therefore requiring volunteers. Fewer volunteers to perform the tasks associated with fire, medical, and rescue operations, can negatively affect a service's ability to respond to emergencies. Additionally, operational needs are impacted if there are fewer volunteers to raise funds. Without fundraising and community support these fire departments and volunteer EMS agencies will experience broader challenges. Municipalities can help offset some of the financial burdens to their local fire company with a fire tax.

There are also challenges for individuals who volunteer, including dedicating time beyond their current employment, family, and community commitments to dedicate to training, responding, and fundraising. Training is essential to provide for the general knowledge and safety of volunteers. Becoming certified as a volunteer firefighter requires hundreds of hours of training. With a decrease in the numbers of new volunteers, many current volunteers are aging and unable to perform at the same levels they once were.

Fire departments and EMS agencies, often are tasked with responding to a variety of emergencies, including not only fire and medical emergencies, but also incidents requiring rescue, containment of hazardous materials, or assistance to law enforcement. Volunteers need to be well trained and able to respond to different scenarios as needed.

The future occurrence of emergency service shortages is likely to continue in Calvert County and across the State of Maryland. With a lack of new recruits and officers for emergency services, response will continue to be hindered and response times will continue to be high. Institutional change is the most efficient way to decrease the likelihood of emergency service shortages in Calvert County, but that type of change is slow and often long-term.

4.3.18.5 Vulnerability Assessment

The possibility that EMS agencies and fire services could fail creates a vulnerability to all Calvert County communities. Occasionally, residents of communities mistakenly think that their local fire department is a paid service. Most municipal fire departments are volunteer agencies and need the support of their communities to maintain their departments.

Personnel shortages have been occurring in law enforcements for several reasons. More students are pursuing other professional careers instead of becoming public safety professionals than previously. This trend could be an effect of the recent changes in the social climate toward law enforcement, the increased number of college students pursuing graduate school degrees, or many other factors. As with any profession, becoming a law enforcement officer requires a commitment of time and money for training at local, state, or federal levels. The selection of law enforcement officers includes not only physical and mental aptitudes, but also a comprehensive physiological screening.

If any current public service agency fails to provide enough personnel to perform their required duties, then those duties must be provided for by another service agency that may be many miles away, creating an increased response time. An increased response time could lead to additional or greater severity in injury or property damage. Many communities in Maryland have already experienced the closure of emergency response agencies.

It is recommended that each municipality assess their own vulnerabilities by maintaining and building relationships with their local providers and working with them to make to plan accordingly for if a local service were to close its operations. Consolidation of services is a possible solution for agencies that are struggling to maintain operations. Statistics, response times, and all times associated with units dispatched are easily obtainable from the county 911 center. Municipalities should research all of the factors which would be part of a consolidation of emergency services with neighboring communities.

The emergency services departments in Calvert County need to be supported to create and or discover new ways to not only recruit but to retain volunteers. If left unattended, the issue will continue and the lack of response will grow, leaving communities more vulnerable to loss of life and loss of property. Community education is a key factor in the maintenance of emergency response agencies. In addition, continued support, and efforts to inform legislature could all prove to be important in assuring that these services remain in operation into the future.

Emergency response agencies that currently provide services within Calvert County are identified in the following tables, *Table 63 – Calvert County Fire Departments* identifies the municipalities served. Almost all fire departments in Calvert County are volunteers. *Table 64 – Calvert County EMS Agencies* identifies each emergency medical service agency and the municipalities served. *Table 65 – Calvert County Law Enforcement Agencies* identifies each police department to include the Maryland State Police (PSP) and the municipalities served. *Table 66 – Calvert County Specialty Teams* lists the teams and their specialty. This information was provided by the Calvert County Emergency Services.

Table 63 - Calvert County Fire Departments

Calvert County Fire Departments	
Station name	Municipalities covered
Dunkirk Volunteer Fire Department	Dunkirk
Huntingtown Volunteer Fire Department and Rescue Squad	Huntingtown
North Beach Volunteer Fire Department	Chesapeake Beach
Prince Frederick Volunteer Fire Department	Prince Frederick
Solomons Volunteer Fire Department and Rescue Squad	Solomons
Saint Leonard Volunteer Fire Department and Rescue Squad	St. Leonard

Table 64 - Calvert County EMS Agencies

Calvert County EMS Agencies			
Station name	Service provided: Basis Life Support (BLS), Advanced Life Support (ALS)	Municipalities covered	
		Full coverage	Portion covered
Dunkirk Fire Department	BLS/ALS		X
Huntington Fire Department	BLS/ALS		X
Prince Frederick Rescue Squad	BLS/ALS		X
Solomons Rescue Squad	BLS/ALS		X
St. Leonard Fire Department	BLS/ALS		X

Table 65 - Calvert County Law Enforcement Agencies

Calvert County Police Departments	
Station name	Municipalities covered
Calvert County Sherriff	All
Maryland State Police/ Prince Frederick Barracks	All
Chesapeake Beach Police Department	Chesapeake Beach

Table 66 - Calvert County Specialty Teams

Calvert County Specialty Teams	
Team Name	Specialty
K-9 Unit	Narcotics detection, explosion detection along with tracking.
Community Action Team (CAT)	Community patrols and selective enforcement activities, and crime prevention activities.
Crime Suppression Team (CST)	Drug Abuse Resistance Education (D.A.R.E) Programs along with recruitment activities.

Calvert County Specialty Teams	
Team Name	Specialty
Special Operation and Homeland Security	Special Operations along with Homeland Security Tasks. (SWAT)
Calvert County Rescue Dive Team (CCRDT)	Responds to all water rescue calls and 100% volunteer.

4.3.19. Environmental Hazards

4.3.19.1 Location and Extent

Transportation

Environmental hazards are most commonly due to hazardous materials incidents occurring when such materials are manufactured, used, stored, or transported. Most hazardous materials incidents are unintentional, however hazardous materials could also be released in a criminal or terrorist act. A release, whether it is intentional or accidental, can result in injury or death and may contaminate air, water and/or soils. Hazardous materials incidents can be generally broken down into the subcategories of transportation and fixed facility. This section will focus on environmental hazards and how they relate to transportation of hazardous materials.

Tanker trucks, tractor trailers, and rail cars often are used to transport hazardous materials. When there are transportation incidents involving these types of vehicles, hazardous materials can be released in significant quantities. *Figure 37 – Environmental Hazard Transportation Vulnerability* shows major transportation routes through Calvert County, including Maryland Route Four along with Route 2-4. Maryland Route 231 travels west from Prince Frederick to the Patuxent River crossing into Charles County. Maryland Route 260 starts at an overpass interchange at the Calvert-Ann Arundel border and travels southeast to Chesapeake Beach.

Fixed Facility

Hazardous materials incidents can be broken down into the subcategories of transportation and fixed facility. This section of the report focuses on environmental hazardous materials at fixed facilities.

In Maryland, facilities that use, manufacture, or store hazardous materials must comply with Title III of the federal Superfund Amendments and Reauthorization Act (SARA). These facilities listed as SARA sites should not be considered an exhaustive and comprehensive list of all locations where hazardous materials reside in the county. *Figure 36 – Hazardous Waste Locations* identifies SARA Title III facilities as well as several other locations that consume, store, or release potentially hazardous materials and wastes.

Fixed facilities are also monitored by the Environmental Protection Agency (EPA). The EPA has identified hazardous materials sites, not regulated by SARA Title III, and are known as Toxic Releases Inventory (TRI) sites. Facilities which employ ten or more full time employees, and which manufacture or process more than 25,000 pounds (or use more than 10,000 pounds) of any SARA Section 313-listed toxic chemical in the course of a calendar year are required to report TRI information to the EPA. The EPA is the federal enforcement agency responsible for SARA Title III and MDEM classifications. As of 2023, there is one TRI facilities in Calvert County.

Oil and gas extraction facilities can also be sources of hazardous material release. Most wells in the county are active, but there are also many inactive and abandoned wells.

4.3.19.2 Range of Magnitude

Transportation

While often accidental, releases can occur because of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, environmental hazards are known as secondary events. Hazardous materials can include toxic chemicals, radioactive materials, infectious substances, or hazardous wastes. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas.

Hazardous material release can contaminate air, water, and soil, and can possibly cause injuries, poisonings, or deaths. Hazardous materials fall into nine hazards classes. These hazard classes are as follows:

- Class #1: Explosives
- Class #2: Gases (flammable, non-flammable, non-toxic, and toxic)
- Class #3: Flammable and Combustible Liquids
- Class #4: Flammable Solids (spontaneously combustible and dangerous when wet materials/water reactive substances)
- Class #5: Oxidizing substances and organic peroxides
- Class #6: Toxic Substances and Infectious Substances
- Class #7: Radioactive Materials
- Class #8: Corrosive Substances
- Class #9: Miscellaneous Hazardous Materials / Substances

All nine hazard classes can be found in transportation incidences.

Fixed Facility

All nine hazard classes can be found at fixed facilities. Certain conditions can exacerbate release incidents and these events include fixed facilities:

- Micrometeorological effects of buildings and terrain which alters the dispersion of hazardous materials.
- Proximity to surface water and ground water resources.
- Compliance with applicable codes (e.g., building or fire codes) and maintenance failures (e.g., fire protection and containment features can substantially increase the damage to the facility itself and to surrounding buildings.

The type of material released, distance, and related response time of emergency responders also significantly impact severity and scope of hazardous material releases and clean-up efforts. Areas most proximal to the release are usually at the greatest level of risk, but depending on the material, a release can travel great distances or remain present in the environment for long periods of time (centuries or millennia for some radioactive materials) resulting in chronic and extensive impacts on people and the environment.

Oil and gas well drilling can have a variety of effects on the environment. Abandoned oil and gas wells not properly plugged can contaminate groundwater and consequently drinking water wells. Surface waters and soil are sometimes polluted by brine, a salty wastewater product of oil and gas well drilling, and from oil spills occurring at the drilling site or from a pipeline breach. A pipeline breach or an accidental dispersal can spoil public drinking water supplies and can be particularly detrimental to vegetation and aquatic animals, making water safety an important factor in oil and gas extraction. In some cases, associated with hydraulic fracturing (fracking), methane has been found contaminating drinking water in surrounding areas.

Natural gas fires occur when natural gas is ignited at the well site. Often, these fires erupt during drilling when a spark from machinery or equipment ignites the gas. The initial explosion and resulting flames have the potential to seriously injure or kill individuals in the immediate area. These fires are often difficult to extinguish due to the intensity of the flame and the abundant fuel source.

4.3.19.3 Past Occurrence

Transportation

In the past, small hazardous material events have occurred in Calvert County that are related to traffic accidents and transportation accidents. More up to date information on past occurrences can be gathered from the Calvert County Division of Emergency Management.

Hazardous materials can be transported by air, sea, and land (over the road or through pipelines). Transportation accidents along roadways is a regular occurrence and a large number of hazardous materials are transported by roadway every day.

<u>Fixed Facility</u>

There have been very few hazardous material incidents in Calvert County related to fixed facilities.

The EPA tracks the management of hazardous materials in facilities that handle significant amounts of hazardous materials. The single toxic release inventory (TRI) facility in Calvert County as of 2023 is summarized in *Table 67 – TRI Facilities*. Production-related waste managed is a collective term to refer to how much of a chemical is recycled, combusted for energy recovery, treated for destruction, or disposed of, or otherwise released on and off site.

Table 67 - TRI Facilities

Toxic Release Inventory Facilities				
Name	**Municipality**	**Industry Sector**	**Chemical**	**Production-related Waste Managed (lbs)**
SMO Barstow Plant	Prince Frederick	4247-Petroleum Bulk Terminals	Benzene, Cumene,	0

Toxic Release Inventory Facilities				
Name	**Municipality**	**Industry Sector**	**Chemical**	**Production-related Waste Managed (lbs)**
			Cyclohexane, Ethylbenzene, Naphthalene, Toluene, Xylene, n-Hexane	
Source: EPA, 2023				

As of 2023, there are no active natural gas wells in Calvert County.

4.3.19.4 Future Occurrence

Transportation

While many incidents involving hazardous material releases have occurred in Calvert County in the past, they are generally difficult to predict. The nature of traffic accidents is that there is little to no warning for their occurrence, and they can have disastrous results. An occurrence is largely dependent upon the accidental or intentional actions of a person or group.

Fixed Facility

Hazardous material release incidents are generally difficult to predict, but the presence of such dangerous materials warrants preparation for accidental or intentional release events. Emergency response agencies in Calvert County should be prepared to handle the types of hazardous materials housed and used the SARA Title III facilities, TRI facilities, and oil and gas wells that are located within the county. The Federal Superfund Amendments and Reauthorization Act (SARA) is also known as the Emergency Planning and Community Right-to-Know Act (EPCRA), and the Local Emergency Planning Committees (LEPCs) are designed by EPCRA to ensure that state and local communities are prepared to respond to potential chemical accidents.

4.3.19.5 Vulnerability Assessment

Transportation

Quick response to transportation accidents involving hazardous materials minimizes the volume and concentration of hazardous materials that are transported and dispersed through the air, water, and soil. Every municipality within Calvert County is vulnerable to hazardous materials incident caused along a transportation route. These incidents can occur along highways, railways, and pipelines. *Figure 37 – Environmental Hazard Transportation Vulnerability Map* identified the 2,000-foot hazard corridor for all major highways in Calvert County. *Figure 38 – Annual Truck Traffic Percentages* identifies the annual truck traffic percentages for all of the roadways in Calvert County.

Fixed Facility

Populations, critical infrastructure, and natural habitats within 1.5 miles of SARA Title III and Toxic Release Inventory sites are vulnerable to hazardous material incidents.

Private water suppliers such as domestic drinking water wells in the vicinity of oil and gas wells are at risk of contamination from brine and other pollutants, including methane, which can pose a fire and explosive hazard. Ideally, vulnerability of private drinking well owners would be established by comparing the distance of drinking water wells to known oil and gas well locations, but this extensive detailed data is not readily available. Private drinking water is largely unregulated and information on these wells is voluntarily submitted to the Maryland Geological Survey by water well drillers, and the existing data is largely incomplete and/or not completely accurate. There are no oil and gas wells in any area of Calvert County. There is a reduced vulnerability to wells to contamination from oil and gas wells in Calvert County.

Figure 36 - Hazardous Waste Locations

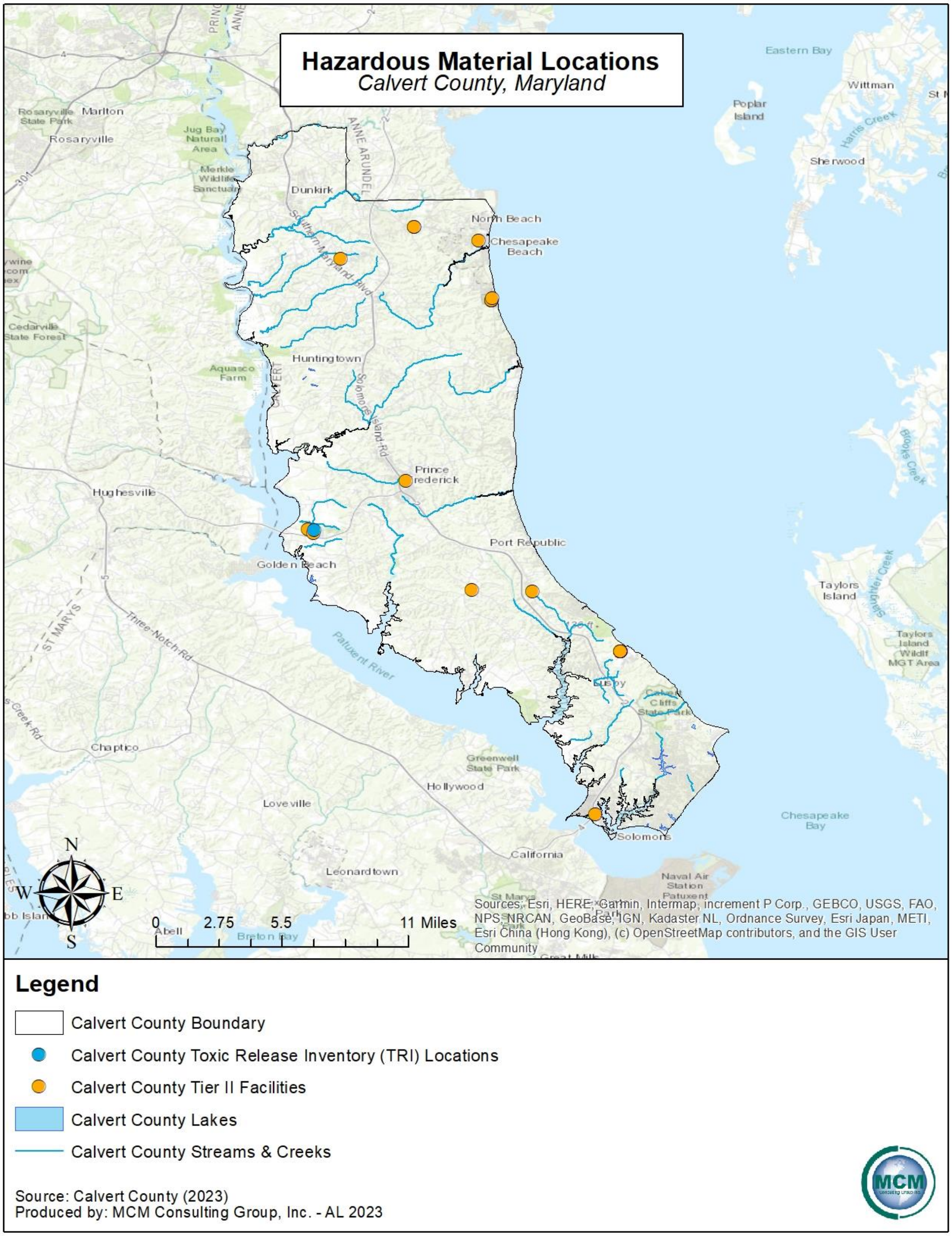
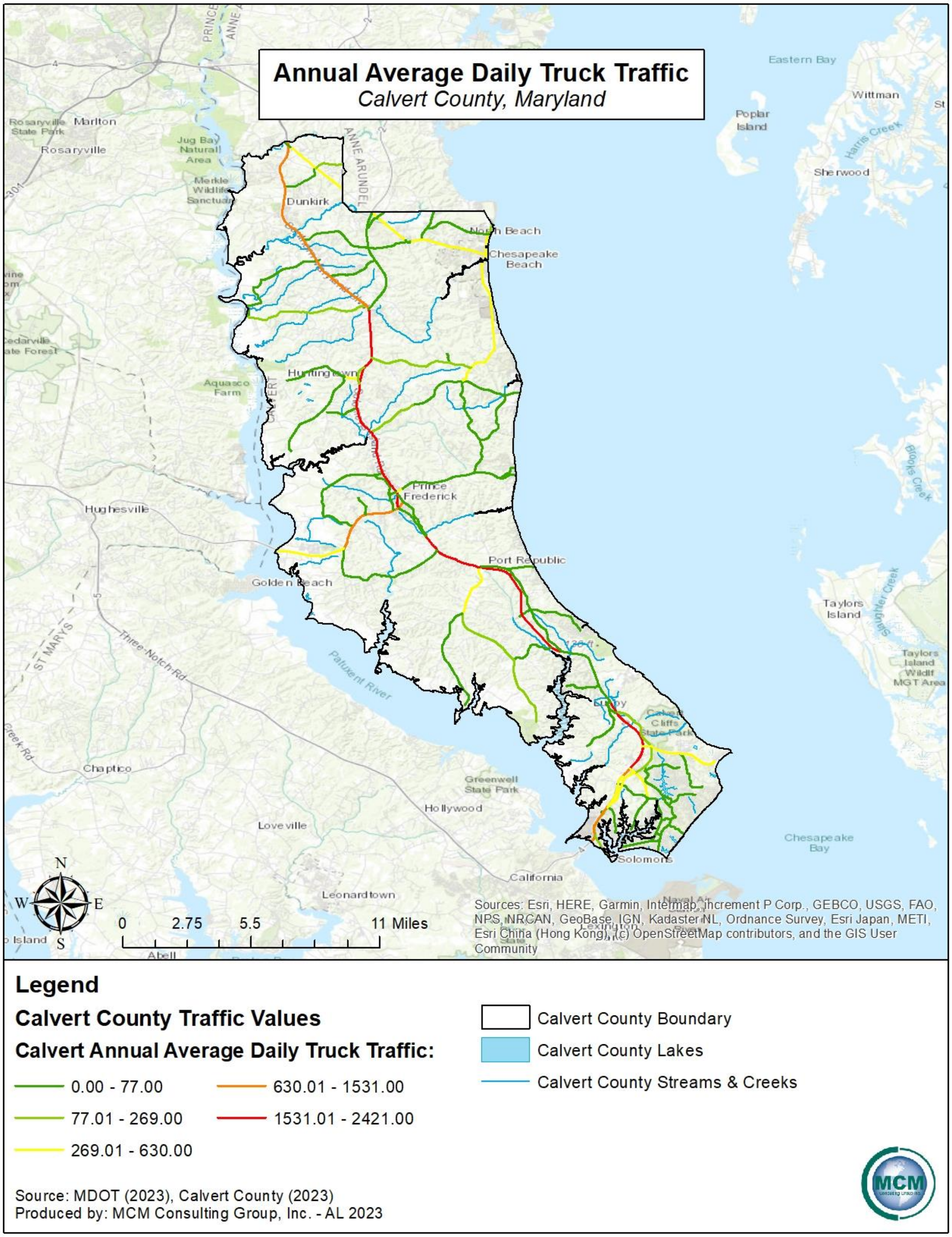


Figure 37 - Environmental Hazard Transportation Vulnerability

Figure 38 - Annual Truck Traffic Percentages



4.3.20. Nuclear Incidents

4.3.20.1 Location and Extent

Nuclear hazards and incidents generally refer to incidents involving (1) a release of significant levels of radioactive materials or (2) exposure of workers or the general public to radiation. Primary concerns following a nuclear incident or accident are:

- the impact on public health from direct exposure to a radioactive plume
- inhalation of radioactive materials
- ingestion of contaminated food, water, and milk
- long-term exposure to deposited radioactive materials in the environment that may lead to acute health effects (e.g., death, burns, severe impairments), chronic health effects (e.g., cancer), and psychological effects

Nuclear accidents/incidents can be placed into three categories:

1. Criticality accidents which involve loss of control of nuclear assemblies or power reactors
2. Loss-of-coolant accidents which result whenever a reactor coolant system experiences a break or opening large enough that the coolant inventory in the system cannot be maintained by the normally operating make-up system
3. Loss-of-containment accidents which involve the release of radioactivity

A nuclear power facility makes electricity by continuously splitting uranium atoms. Within the State of Maryland, there is only one nuclear power station.

- Calvert Cliffs Nuclear Power Plant is located in Lusby, Maryland.

The only nuclear power station within Maryland is located in Calvert County. All of the municipalities in Calvert County are in the 50-mile ingestion exposure pathway for the Calvert Cliffs Nuclear Power Plant.

Nearly all of the county is within the fifty-mile planning zone of Calvert Cliffs nuclear Power Plant. In the event of an emergency, evacuees from distant EPZs may seek shelter in Calvert County or pass through the county and use local services.

4.3.20.2 Range of Magnitude

The Nuclear Regulatory Commission encourages the use of Probabilistic Risk Assessments (PRAs) to estimate quantitatively the potential risk to public health and safety considering the design, operations, and maintenance practices at nuclear power plants. PRAs typically focus on accidents that can severely damage the core and that may challenge containment. The Federal Emergency Management Agency (FEMA), the Maryland Department of Emergency Management (MDEM), and county governments have formulated Radiological Emergency Response Plans that include a Plume Exposure Pathway Emergency Planning Zone (EPZ) with a radius of about ten miles from each nuclear power facility and an Ingestion Exposure Pathway

EPZ with a radius of about fifty miles from each facility. See *Table 68 - Emergency Planning Zones*. The exact size and configuration of the EPZ may vary in relation to local emergency response capabilities, topography, road networks, and political boundaries.

Table 68 - Emergency Planning Zones

Emergency Planning Zones	
EPZ	**Description**
Plume Exposure Pathway (PEP)	Has a radius of about 10 miles from each reactor site. Predetermined protective action plans are in place and include sheltering, evacuation, and the use of potassium iodide where appropriate.
Ingestion Exposure Pathway (IEP)	Has a radius of about 50 miles from each reactor site. Predetermined protective action plans are in place and are designed to avoid or reduce dose from potential ingestion of radioactive materials. These actions include a ban of contaminated food and water.
Source: U.S. Nuclear Regulatory Commission http://www.nrc.gov/about-nrc/emerg-preparedness/about-emerg-preparedness/planning-zones.html	

The magnitude of a nuclear incident differs for those within the Plume Exposure Pathway EPZ and those within the Ingestion Exposure Pathway EPZ. The Plume Exposure Pathway refers to whole-body external exposure to gamma radiation from a radioactive plume and from deposited materials and inhalation exposure from the passing radioactive plume. The duration of primary exposures could range in length from hours to days. The Ingestion Exposure Pathway refers to exposure primarily from ingestion of water or foods such as milk and fresh vegetables that have been contaminated with radiation.

Fixed facility incidents are not the only types of incidents that could affect Calvert County. Other types of incidents such as transportation or terrorism could also pose a hazard. The U.S Department of Defense Naval Research Laboratory is located within the county borders and could pose a significant threat as a terrorism target.

In the event of a nuclear disaster, radioactive fallout would be the main danger of an incident within a fifty-mile radius. Invisible gamma rays from this fallout can cause radiation sickness due to physical and chemical changes in the cells of the body. If a person would receive a large dose of radiation, that person would die in a very short time. Non-lethal doses in varying degrees would cause radiation sickness among the survivors. Depending on the location of the event all Calvert County could be in the Ingestion Exposure Pathway.

The Nuclear Regulatory Commission uses four classification levels for nuclear incidents:

1. Unusual Event: Events are in process or have occurred which indicate potential degradation in the level of safety of the plant. No release of radioactive material requiring offsite response or monitoring is expected unless further degradation occurs.
2. Alert: Events are in process or have occurred which involve an actual or potential substantial degradation in the level of safety of the plant. Any releases of radioactive material from the plant are expected to be limited to a small fraction of the EPA Protective Action Guides (PAGs).
3. Site Area Emergency: Involves events in process or which have occurred that result in actual or likely major failures of plant functions needed for protection of the public. Any releases of radioactive material are not expected to exceed the EPA PAGs except near the site boundary.
4. General Emergency: Involves actual or imminent substantial core damage or melting of reactor fuel with the potential for loss of containment integrity. Radioactive releases during a general emergency can reasonably be expected to exceed the EPA PAGs for more than the immediate site area.

The nuclear industry has adopted predetermined, site-specific Emergency Action Levels (EALs). The EALs provide the framework and guidance to observe, address, and classify the severity of site-specific incidents and conditions that are communicated to off-site emergency response organizations (Nuclear Regulatory Commission, 2008). There are additional EALs that specifically deal with issues of security, such as threats of airborne attack, hostile action within the facility, or facility attack. These EALs ensure that appropriate notifications for the security threat are made in a timely manner. Each facility is also equipped with a public alerting system, which includes several sirens to alert the public located in the Plume Exposure Pathway EPZ. This alerting system is activated by the counties of each specific EPZ.

During and after a nuclear incident, the primary concern is the effect on the health of the population near the incident. The duration of primary exposure could range in length from hours to months depending on the proximity to the point of radioactive release. External radiation and inhalation and ingestion of radioactive isotopes can cause acute health effects (e.g., death, severe health impairment), chronic health effects (e.g., cancers) and psychological effects.

Potential environmental impacts specific to the fifty-mile Ingestion Exposure Pathway EPZ, and therefore of most concern to Calvert County, include the long-term effects of radioactive contamination in the environment and in agricultural products. Calvert County can expect some radioactive contamination in the case of a nuclear incident at the Calvert Cliffs Nuclear Power Plant. This is not a significant concern in terms of external exposure and immediate health risks, but even a small amount of radiation will require the protection of the food chain, particularly milk supplies. Small amounts of radiation ingested over time could lead to future health issues. As a result, in the case of a nuclear incident, foodstuffs, crops, milk, livestock feed and forage, and farm water supplies will need to be protected from and tested for contamination.

Additionally, spills and releases of radiologically active materials from accidents can result in the contamination of soil and public water supplies. Areas underlain by limestone and some types of glacial sediments are particularly susceptible to contamination.

The worst-case scenario for Calvert County would be a General Emergency at Calvert Cliffs Nuclear Power Plant that leaked sufficient radiation to create longer-term damage in the form of contaminated water, soil, and food supplies.

4.3.20.3 Past Occurrence

Nuclear incidents rarely occur, but the incident at Three Mile Island in Dauphin County, Pennsylvania is the worst fixed nuclear facility accident in U.S. history. The resulting contamination and state of the reactor core led to the development of a 14-year cleanup and scientific effort. Additionally, the *President's Commission on the Accident at Three Mile Island* examined the costs of the accident, concluding that "the accident at Three Mile Island on March 28, 1979, generated considerable economic disturbance. Some of the impacts were short term, occurring during the first days of the accident. Many of the impacts were experienced by the local community; others will be felt at the regional and national levels." The report concluded: "It appears clear that the major costs of the TMI Unit 2 accident are associated with the emergency management replacement power and the plant refurbishment or replacement. The minimum cost estimate of nearly one billion dollars supports the argument that considerable additional resources can be cost effective if spent to guard against future accidents."

Another incident occurred at Three Mile Island on February 7, 1993, when an individual drove his car through a chain-link fence and then slammed into a roll-up garage door leading into the facility's turbine building. Plant officials, fearing the worst, immediately declared a Site Area Emergency. Fortunately, the person who crashed the gate was found and apprehended. Other than property damage caused by the forcible entry through physical structures, there was no lasting damage to the facility.

Calvert County has not been affected by a fixed nuclear facility incident from the local or other state facilities. The county has not been affected by any type of nuclear incident. There have been no major nuclear incident events in Maryland.

4.3.20.4 Future Occurrence

Since the Three Mile Island incident, nuclear power has become significantly safer and is one of the most heavily regulated industries in the nation. Despite the knowledge gained since then, there is still the potential for a similar accident to occur again at any of the nuclear generating facilities nearest the county. The Nuclear Energy Agency of the Organization for Economic Co-Operation and Development notes that studies estimate the chance of a breach of protective barriers in a modern nuclear facility at less than one in 100,000 per year (Nuclear Energy Agency, 2005). Nuclear incident occurrences may also happen because of intentional actions, but these terrorist acts are rare. Nuclear incidents in or near Calvert County should be considered unlikely.

4.3.20.5 Vulnerability Assessment

In addition to the areas of Calvert County facing direct contamination risk, the entire county could also be affected on some level by incidents from any other nearby nuclear facilities, including the one at Calvert Cliffs Nuclear Power Plant. Evacuation of residents from these areas could lead to increased population or through-traffic in the county. County residents could be negatively impacted through the psychological effects of a nuclear incident as the effects and likelihood of radiation contamination are not always well understood by the public.

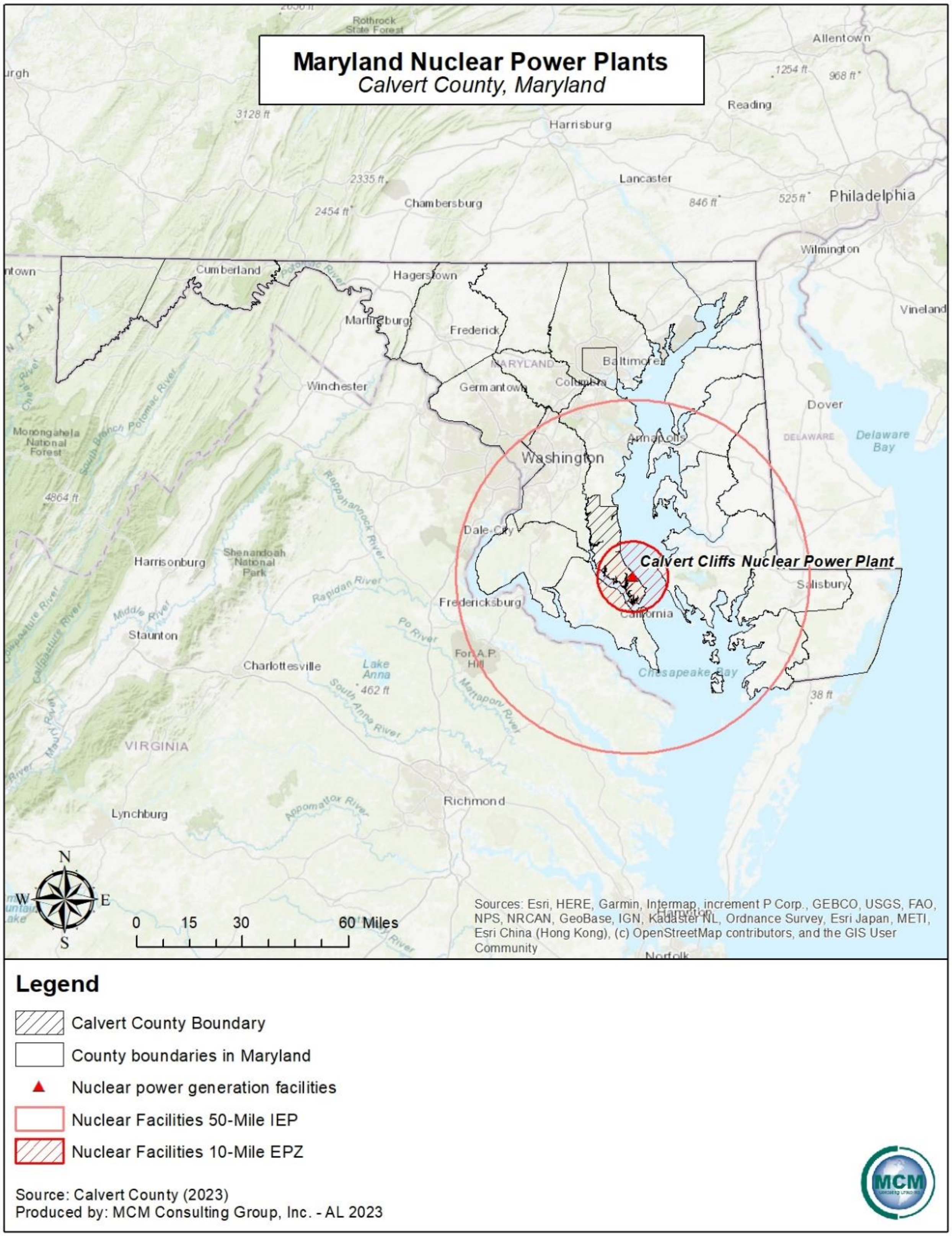
All of Calvert County's municipalities fall wholly or partially within the fifty-mile EPZ of Calvert Cliffs Nuclear Power Plant. According to the 2019 U.S. Census Estimate, this represents a population of 93,928 and covers the bulk of Calvert County's agricultural land cover. These jurisdictions include Chesapeake Beach and North Beach.

The county's primary vulnerability to nuclear incidents comes in the form of food, soil, and water contamination. In terms of vulnerable land, the majority of the 25,152 acres of farmland held in Calvert County's 280 farms are vulnerable to radiological contamination in a nuclear incident. In 2017, the market value of all agricultural products of these farms was nearly $6,322,000 million.

Water contamination is also a concern in nuclear incidents. There are several public water suppliers that operate in or provide water to the county; the largest of them are: Calvert Co Water and Sewage, Calvert County Water and Sewer, Chesapeake Ranch Water Association and the Beaches Water Company Inc. These water supplies, coupled with the county's six monitored wells estimated domestic drinking water wells, are all vulnerable to the effects of a nuclear incident.

While unlikely that all agricultural products would be lost in the event of a nuclear incident, the county could expect some portion of that $6,322,000.00 to be lost. Time of year also impacts the vulnerability and losses estimated for a nuclear incident. An incident that occurs during the prime growing and harvesting season will have a larger impact on the county.

Figure 39 - Maryland Nuclear Power Stations



4.3.21. Opioid Epidemic

4.3.21.1 Location and Extent

Maryland and the United States at large have been experiencing an epidemic of opioid drug abuse. According to the Maryland Department of Health, the opioid overdose epidemic is the worst public health crisis in Maryland. It affects Marylanders across the state, from big cities to rural communities. Opioid addiction has increased drastically over the last year due to the hardships faced from the COVID-19 pandemic. Opioid use has increased since the beginning of the COVID-19 pandemic which is being attributed to the uncertainty people are feeling due to the pandemic.

Opioids, mainly synthetic opioids (other than methadone), are currently the main driver of drug overdose deaths. According to the Center for Disease Control and Prevention (CDC), 72.9% of opioid-involved overdose deaths involved synthetic opioids. Opioid addiction occurs when an individual becomes physically dependent on opioids. Opioids are a class of drug that reduces pain by interacting with receptors on nerve cells in the body and brain. The use of opioids is a broad term and includes opiates, which are drugs naturally extracted from certain types of poppy plants, and narcotics. Opioids can also be synthetically made to emulate opium. Opioid drugs are highly addictive and typically result in increasing numbers of overdose deaths both prescribed (e.g. fentanyl) and illicit (e.g. heroin) opioids. Overdose deaths from opioids occur when a large dose slows breathing, which can occur when opioids are combined with alcohol or antianxiety drugs. While generally prescribed with good intentions, opioids can be over-prescribed, resulting in addiction.

According to the Drug Enforcement Administration (DEA), opioids come in various forms such as tablets, capsules, skin patches, powder, chunks in various colors from white to brown/black, liquid form for oral or injection use, syrups, suppositories, and lollipops. The Centers for Disease Control and Prevention (CDC) defines the following as the three most common types of opioids:

- **Prescription Opioids**: Opioid medication prescribed by doctors for pain treatment. These can be synthetic oxycodone (OxyContin), hydrocodone (Vicodin), or natural (morphine).
- **Fentanyl**: A powerful synthetic opioid that is 50 to 100 times more powerful than morphine and used for treating severe pain; illegally made and distributed fentanyl is becoming more prevalent.
- **Heroin**: An illegal natural opioid processed from morphine which is becoming more commonly used in the United States.

Opioids are highly addictive. They block the body’s ability to feel pain and can create a sense of euphoria. Additionally, individuals often build a tolerance to opioids, which can lead to misuse and overdose.

While other addictive substances such as methamphetamines and alcohol can be problematic for the health of individuals in Calvert County, this profile focuses on opioid drugs and the opioid epidemic. On March 1, 2017, Governor Larry Hogan signed an executive order that declared a state of emergency related to heroin and opioid crisis.

4.3.21.2 Range of Magnitude

Opioid addiction can lead to overdose, which can be fatal. This type of addiction can affect others that are not the user themselves. The most dangerous side effect of an opioid overdose is depressed breathing. The lack of oxygen to the brain causes permanent brain damage, leading to organ failure, and eventually death. Signs and symptoms include respiratory depression, drowsiness, disorientation, pinpoint pupils, and clammy skin. Opioid addiction can also be passed from mother to child in the womb. This condition, known as neonatal abstinence syndrome, has increased five-fold, according to the National Institute on Drug Abuse (NIDA). This results in an estimated 22,000 babies in the United States born with this condition. First responders such as paramedics, police officers, and firefighters are also affected by the opioid addiction crisis. First responders face exposure risk due to an increase in emergency calls due to an increase in the crisis, particularly to synthetic fentanyl. Two to three milligrams of fentanyl can cause an induced respiratory depression, arrest, and possibly death to occur. Since fentanyl is indistinguishable from several other narcotics and powdered substances, first responders must take extra precaution when dealing with calls related to drug abuse. A worst-case scenario with the opioid epidemic in Calvert County would be a high number of overdoses between residents and/or first responders throughout the county.

According to the Center for Disease Control and Prevention (CDC), more than 192 Americans die every day from an opioid overdose. In 2021, a total of 2,737 deaths related to opioid use occurred in Maryland with the average age of 35-44 years old. From February 2018 to February 2021, there has been an 8.28% increase across the State of Maryland. This could indicate a significant increase in opioid overdoses in Maryland. Heroin and fentanyl are the two drugs most often found in overdose deaths, and they are considered to be highly available and nearly ubiquitous in Maryland.

4.3.21.3 Past Occurrence

In 2021, there was an estimated total of 106,000 drug-related overdose deaths in the United States. This is the highest number of overdose deaths ever recorded in a 12-month period, according to the recent provisional date from the CDC. Calvert County experienced a total of 140 drug related deaths from 2015 – 2020. There was a total of nineteen overdose deaths in 2015, twenty-five deaths in 2016, twenty-seven deaths in 2017, twenty-five deaths in 2018, twenty-five deaths in 2019, and nineteen in 2020. The most common age group for opioid abuse in Calvert County is the 35-44 years of age demographic. In Calvert County the overdose rate of males is greater than the overdose rate of females. Whites have the highest total rate of overdose deaths in Calvert County, while blacks have the highest per capita rate of overdose deaths when adjusted for population size. The most used opioid in Calvert County are fentanyl, heroin, cocaine, benzodiazepines, and Rx opioids.

Table 69 - Drugs Present in 2020 Maryland Overdose Deaths

Drugs Present in 2020 Maryland Overdose Deaths	
Drug Category	**Percent Reported Among 2020 Decedents**
Cannabis	25%
Cocaine	20%
Heroin	15%
Fentanyl	14%
Methamphetamine	10%
Prescription Opioids	5.5%
Cathinones	5.5%
Benzodiazepines	5%
Source: DEA, 2020	

4.3.21.4 Future Occurrence

Both Calvert County, and Maryland as a whole, have seen a steady rise in opioid related deaths over the last several years, with drug-related death rates increasing at a high percentage. Future occurrences of opioid addiction and overdose are unclear as the state moves forward with overdose prevention initiatives through the use of Naloxone, alternative pain treatments, improvement of tools for families and first responders, and expansion of treatment access. The Maryland government has taken various approaches to help with the prevention of mass future occurrences across the state. To help prevent future drug abuse and protect individual health among communities in Maryland, the Maryland's Prescription Drug Monitoring Program (MPDMP) collects information on all filled prescriptions for controlled substances. This information helps health care providers safely prescribe controlled substances and helps patients get correct treatment. The MPDMP also has drug take-back boxes located in the counties for an easy, convenient location where anyone can dispose of their unused, expired, or unwanted prescriptions to help lower potential drug overuse. In Calvert County, there are two drug take-back boxes located throughout the county. The drug take-back box locations include Calvert County Sheriff Department and the State Police Barracks in Prince Frederick MD. These locations help reduce future occurrences of opioid use from occurring.

In the event of an opioid overdose, death can sometimes be prevented with the use of the drug naloxone. According to a study published in September 2018, drug users reported that users often have multiple overdoses in the course of their drug use, and availability of naloxone has saved many lives. While the introduction of naloxone has been a significant benefit to the fight against opioid abuse, efforts to prevent future overdoses are still underway. Naloxone is another way to reduce future occurrences of the opioid epidemic from occurring in Calvert County.

Opioid drugs have been a problematic and addictive method for patients to deal with pain. Employing alternative approaches to pain management could prevent patients from ever being introduced to addictive opioids, especially considering the most common overdose drugs in Calvert County have been prescription opioids. A possible alternative pain treatment comes from hemp extracted cannabidiol, or CBD. Unlike THC (the psychoactive constituent of cannabis), CBD is non-psychoactive and does not have the same intoxicating effect as THC; however, CBD can provide relief from pain, inflammation, anxiety, and even psychosis. CBD is legal without a prescription throughout the United States of America.

4.3.21.5 Vulnerability Assessment

Opioid overdoses have resulted in many tragic deaths in Maryland and many people have been affected by the epidemic through the loss of either a family member, a close friend, or member of their community. Opioid addiction is a direct detriment to the personal wellbeing of addicts, a burden to their families and communities, and a strain to the emergency response system that cares for overdose victims. In general, jurisdictions that are more densely populated are more vulnerable to opioid addiction threats as access to the drugs increases. However, rural communities in general experience larger per-capita opioid-related deaths. Jurisdictional losses in the opioid addiction crisis stem from lost wages, productivity, and resources rather than losses to buildings or land. Many counties across the state, including Calvert County, have seen an increase of time and resources devoted to the opioid epidemic as overdose and response increase.

The vulnerability in the county depends on the number of additional risk factors on the vulnerable population such as genetic, psychological, and environmental factors that play a role in addiction. The known risk factors of opioid misuse and addiction include poverty, unemployment, family and/or personal history of substance abuse, history of criminal activity, history of severe depression or anxiety, and prior drug/alcohol rehabilitation. In addition, women have a unique set of risk factors for opioid addiction. Women are more likely than men to have diagnosed chronic pain. Compared with men, women are also more likely to be prescribed opioid medications, to be given higher doses, and to use opioids for longer periods of time. Women may also have biological tendencies to become dependent on prescription pain relievers more quickly than men. Therefore, if the county were to have a population with a great amount of these risk factors, the county would be very vulnerable to the opioid epidemic.

The COVID-19 pandemic and its periods of quarantine caused vulnerability in opioid users throughout Calvert County. It is likely that the emergence of COVID-19 and subsequent disruptions in health care and social safety nets combined with social and economic stressors has fueled the opioid epidemic. The COVID-19 pandemic has challenged vulnerable populations, including those with opioid use disorders. The opioid epidemic and COVID-19 pandemic are intersecting and presenting unprecedented challenges for families and communities. Opioid use affects respiratory and pulmonary health which may make those with opioid use disorders more susceptible to COVID-19. In addition, chronic respiratory disease is already known to increase overdose mortality risk among people taking opioids, and decreased lung capacity from COVID-19 could lead to similar health effects. Secondary impacts from the COVID-19 pandemic, including disruptions of treatment and recovery services, limited access to mental health services and peer support, disrupted routines, loss of work, and stress, may lead to increased opioid use and risk of relapse for those in recovery. Risk factors also arise from indirect factors including housing instability and incarceration. Those with opioid use disorders are at higher risk for housing insecurity, homelessness, and incarceration. Congregate living facilities such as homeless shelters, jails, and prisons are high-risk environments for coronavirus transmission, and there are challenges in implementing recommendations from the CDC such as social distancing and quarantine. Additionally, the pandemic took away the attention from the media, from legislators, and from public health agencies that was being focused on the opioid crisis. The opioid epidemic in Maryland increased 22.9% since the beginning of the pandemic.

Additionally, first responders and medical personnel are also a very vulnerable population when dealing with the opioid epidemic. Fentanyl and related substances are hazardous materials, which cause the environment and the people around the substance to be vulnerable. Contact with fentanyl can impact first responders and others that are related to the opioid user. Depending on the potency of the drug, it can take as little as the equivalent of few grams of table salt to cause health complications. There have been several reports nationally of first responders accidentally overdosing on fentanyl through brief skin contact or the drug becoming airborne. It is best for first responders to err on the side of caution to avoid any potential exposure. The American College of Medical Toxicology (ACMT) and the American Academy of Clinical Toxicology (AACT) suggest that nitrile gloves provide sufficient protection for handling fentanyl, and for "exceptional circumstances where the drug particles or droplets suspended in the air, an N95 respirator provides sufficient protection". Other environmental structures such as streams, rivers, and lakes have been known to contain traces of opioids and other drugs within them. These traces come from human urine, feces, or medications that have been discarded in the bathroom. The Environmental Protection Agency (EPA) suggests that while the risks of pharmaceuticals found in wastewater, ambient water, and drinking water are low, further research is needed. State facilities are not at risk to the opioid crisis, but there are some occupation-specific risks that may make some employees more vulnerable. State employees working in direct patient care are vulnerable to fentanyl exposure. However, the physical plant and facilities of the state and Calvert County are not likely to experience losses from the opioid addiction crisis. Absenteeism associated with an opioid addiction in state facilities located in high-risk areas could lead to economic loss through lost productivity and increased medical costs. *Figure 40 – Overdose Deaths in Maryland 2022* and *Figure 41 – Overdose Deaths in Maryland 2023* illustrate the number of deaths per county in the state of Maryland.

Figure 40 - Overdose Deaths in Maryland 2022

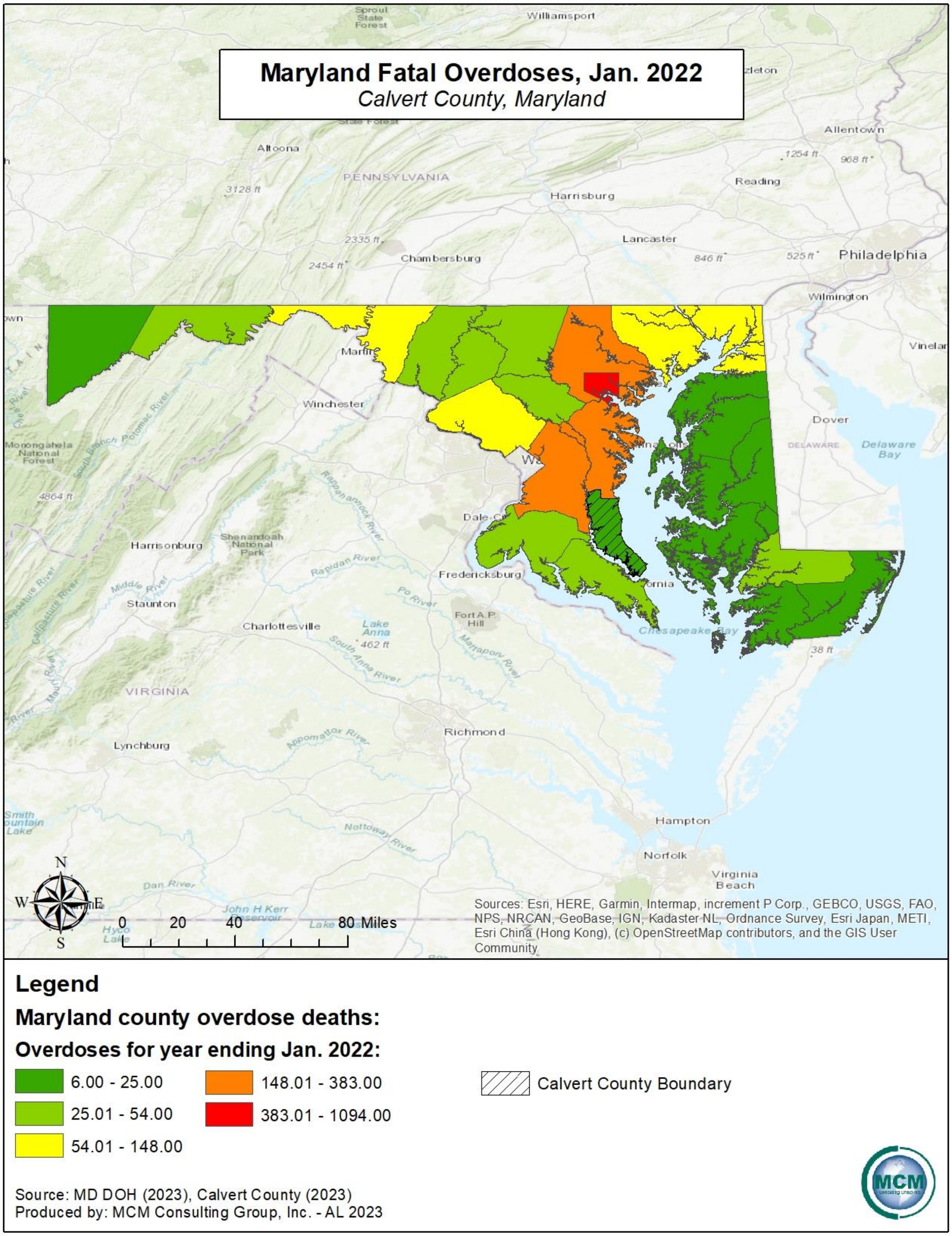
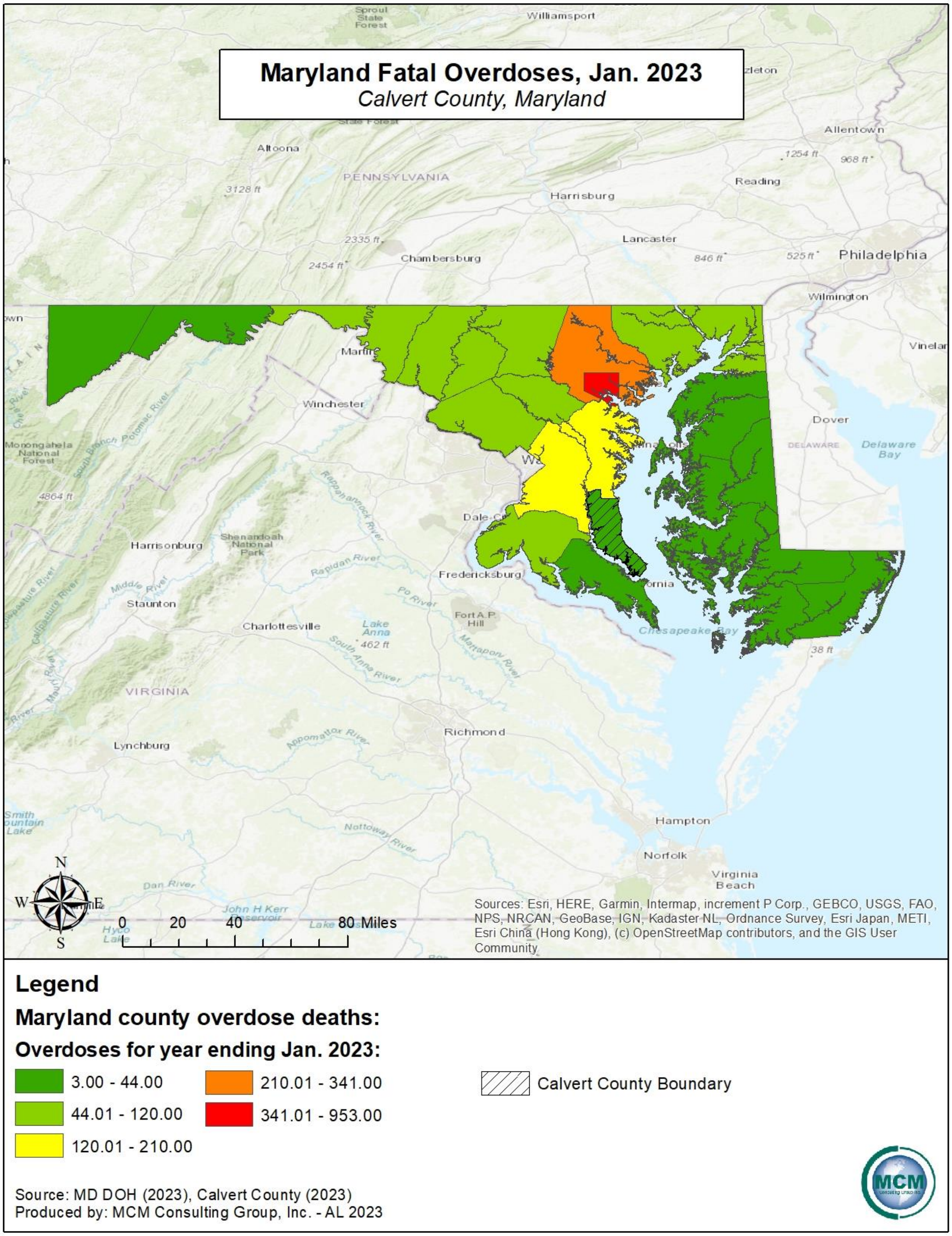


Figure 41 - Overdose Deaths in Maryland 2023



4.3.22. Terrorism and Cyberterrorism

4.3.22.1 Location and Extent

Following several serious international and domestic terrorist incidents during the 1990s and early 2000s, citizens across the United States paid increased attention to the potential for deliberate, harmful actions of individuals or groups. The term “terrorism” refers to intentional, criminal, malicious acts. The functional definition of terrorism can be interpreted in many ways. Officially, terrorism is defined in the Code of Federal Regulations as “…the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.” (28 CFR §0.85)

Cyber-terrorism is the unlawful use of force and violence over technological methods to cause harm to financial security, identity information, personal information, and attacking personal computers, mobile phones, gaming systems, and other Bluetooth or wirelessly connected devices. Cyber-terrorism can be just as damaging to infrastructure as conventional terrorism, due to the large amount of business that is carried out over the internet, through wirelessly connected devices, or from employees of companies working remotely.

The Federal Bureau of Investigations (FBI) further characterizes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization. Often, the origin of the terrorist or person causing the hazard is far less relevant to mitigation planning than the hazard itself and the consequences. However, it is important to consider that the prevalence of homegrown violent extremists (HVEs) has increased in recent years, with individuals able to become radicalized on the internet. In a speech on August 29, 2018, addressed to the 11th annual Utah National Security and Anti-Terrorism Conference, FBI Director Christopher Wray describes HVEs as “the primary terrorist threat to the homeland here today, without question.”

Community lifeline facilities are either in the public or private sector that provide essential products and/or services to the general public. Community lifeline facilities are often necessary to preserve the welfare and quality of life in the county, or fulfill important public safety, emergency response, and/or disaster recovery functions. Community lifeline facilities identified in the county are hospitals and health care facilities, schools, childcare centers, fire stations, police departments, municipal buildings, and hazardous waste facilities. In addition to critical facilities, the county contains at risk populations that should be factored into a vulnerability assessment. These populations include not only the residents and workforce in the county, but also the tourists that visit the area on a daily basis, those that are traveling through the county on any major highway and marginalized groups such as LGBTQ persons and racial, religious, or other minorities.

Potential targets include:

- Commercial facilities
- Family planning clinics/organizations associated with controversial issues
- Education facilities
- Events attracting large amounts of people
- Places of worship
- Industrial facilities, especially those utilizing large quantities of hazardous materials
- Transportation infrastructure
- Historical sites
- Cultural sites
- Government facilities

4.3.22.2 Range of Magnitude

Terrorism may include use of Weapons of Mass Destruction (WMD) (including chemical, biological, radiological, nuclear, and explosive weapons) which include arson, incendiary, explosive, armed attacks, industrial sabotage, intentional release of hazardous materials, and cyber-terrorism. Within these general categories, there are many variations. There is a wide variety of agents and ways for them to be disseminated, particularly in the case of biological and chemical weapons.

Terrorist methods can take many forms including:

- Active assailant
- Agri-terrorism
- Arson/incendiary attack
- Armed attack
- Assassination
- Biological agent
- Chemical agent
- Cyber-terrorism
- Conventional bomb or bomb threat
- Hijackings
- Release of hazardous materials
- Kidnapping
- Nuclear bomb
- Radiological agent

Active assailant incidents and threats can disrupt the learning atmosphere in schools, interfere with worship services, cause traffic to be re-routed, and use taxpayer assets by deploying police, EMS and/or fire units. Calvert County has one district (public schools K through 12th grade) that include twenty-three primary, secondary, and high schools. There are two post-secondary education schools located in Calvert County.

The areas along major transportation routes can be susceptible to forms of public transit terrorist attacks. More populated areas of the county, including the county seat of Prince Frederick, can be susceptible to chemical, biological, radiological, nuclear, or explosive (CBRNE) events due to the concentration and density of residential communities and government activity and buildings. Secondary effects from CBRNE incidents can be damaging as well. Mass evacuations could result in congestion of roadways and possibly result in breakdown of civil order, further exacerbating the situation. Government operations may be disrupted due to the need to displace or operate under reduced capacity. Radiation fallout, hazardous chemical introduction into the groundwater or biologic/germ agents can cause long-term environmental damage.

Cyber terrorism is becoming increasingly prevalent. Cyber terrorism can be defined as activities intended to damage or disrupt vital computer systems. These acts can range from taking control of a host website to using networked resources to directly cause destruction and harm. Protection of databases and infrastructure are the main goals for a safe cyber environment. Cyber terrorists can be difficult to identify because the internet provides a meeting place for individuals from various parts of the world. Individuals or groups planning a cyber-attack are not organized in a traditional manner, as they are able to effectively communicate over long distances without delay. The largest cyber terrorism threat to institutions comes from any processes that are networked or controlled via computers.

Ransomware continues to be the leading threat, with Maze ransomware accounting for nearly half of all known cases in 2020. Cybercriminals have increasingly begun to steal proprietary – and sometimes embarrassing – data before encrypting it. The cybercriminal will then threaten to publicly release the stolen files if the victims do not provide financial transactions.

4.3.22.3 Past Occurrence

No major terrorism or cyber terrorism events have occurred in Calvert County, Maryland. Cyber terrorism events are becoming more common in areas of local government, and these include counties near Calvert County, MD.

Significant international terrorism incidents in the United States include the World Trade Center bombing in 1993, the bombing of the Murrah Building in Oklahoma City in 1995, and the September 11th, 2001, attacks on the World Trade Center and the Pentagon.

While the largest scale terrorist incidents have often had international stimuli, many other incidents are caused by home grown actors who may have become radicalized through hate groups either in person or via the internet, and who may struggle with mental health issues. Hate groups such as the Ku Klux Klan (KKK), Aryan Nation, the New Black Panther Party, and more recently, the Alt-Right, Antifa, anarcho-communists, Proud Boys, plus conspiracy theorist believers/promoters such as QAnon, have been part of domestic terrorism in different forms.

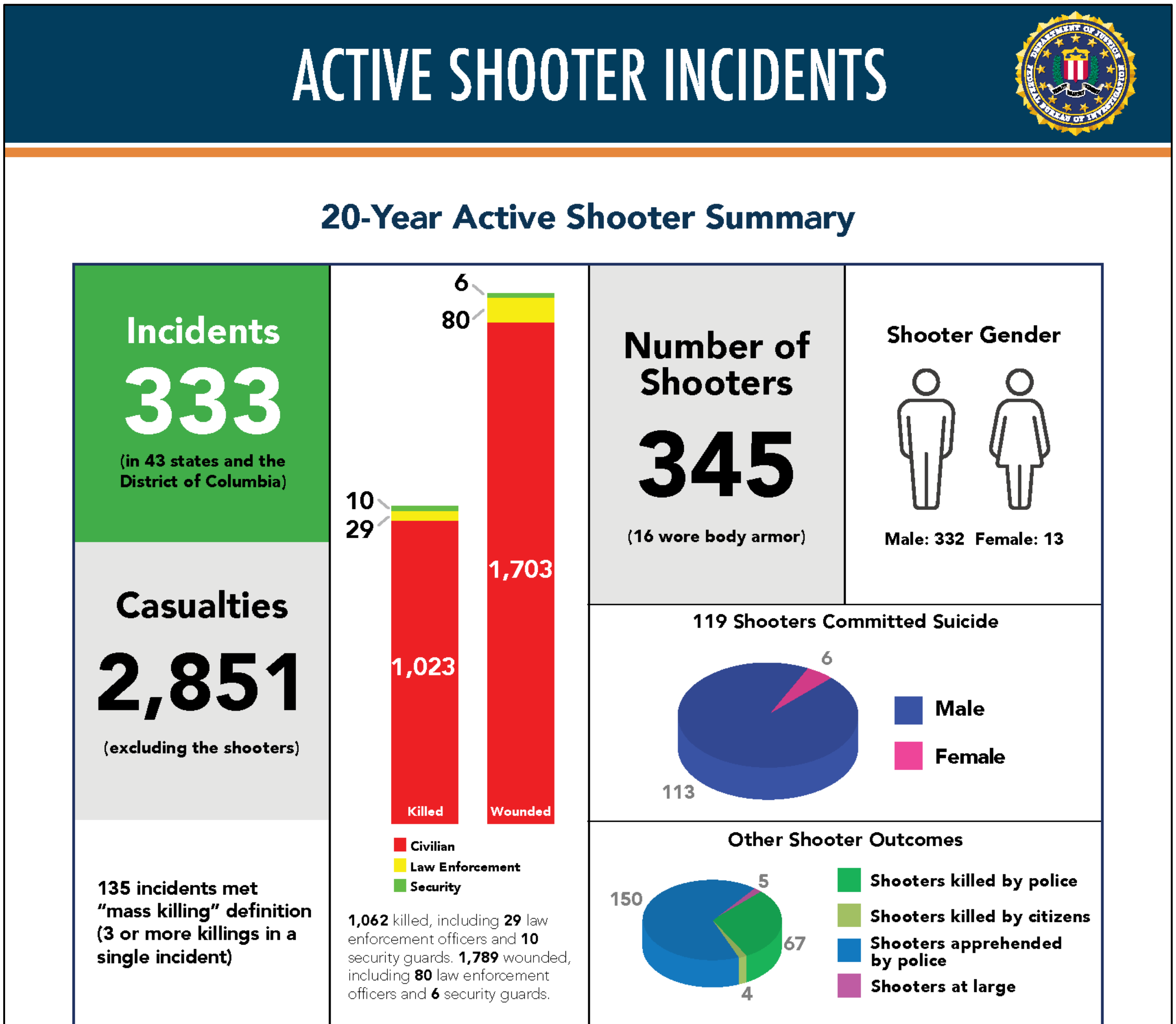
During the May 2020 George Floyd protests, anti-police individuals associated with one or more of the groups created incendiary devices to burn down the Minneapolis Third Precinct. On January 6, 2021, individuals associated with one or more of the groups, stormed the United States Capitol to disrupt the certification of the 2020 presidential election, resulting in five deaths and evacuation of Congress.

Active Shooters

An active assailant (shooter), as defined by the U.S. Department of Homeland Security, is an individual actively engaged in killing or attempting to kill people in a confined area, in most cases, active shooters use firearms and there is not necessarily a pattern or method to their selection of victims. Throughout the year in 2021, there were a total of at least 690 mass shooting incidents in the United States according to the Gun Violence Archive. Often these shooters are HVEs. One of the most tragic recent active shooters occurred in Uvalde, Texas, where an armored and masked gunman entered the Robb Elementary School on May 24, 2022 and killed nineteen students and two teachers. Another active shooter event occurred on November 22, 2022 when an employee at a Walmart in Chesapeake, Virginia entered the breakroom of the Chesapeake Walmart and killed six individuals before taking his own life.

Other active shooter events in the United States in recent years include Virginia Tech (April 2007), Sandy Hook Elementary School (December 2012), San Bernardino, California (December 2015), an Aurora, Colorado movie theater (July 2012) a church in Charleston, South Carolina (June 2015). An *Active Shooter Incidents 20-Year Review* by the FBI concluded that there has been a significant recent increase in frequency of active shooter incidents, and that most shooters were male. The report documents data from all the incidents, including location, commercial environments, educational environments, open spaces, military and other government properties, residential locations, houses of worship, and health care facilities (FBI, 2021). *Figure 42– Active Shooter Incidents – 20 Year Active Shooter Summary* is one page from the report that illustrates a numerical breakdown of shooting events for those twenty years. *Figure 43 – Education Environments* and *Figure 44 – Education Environments Cont'd* shows two more summary pages from the report that detail active shooter statistics in educational environments.

Figure 42 - Active Shooter Incidents - 20 Year Active Shooter Summary



Incidents: 333 (in 43 states and the District of Columbia). Total casualties: 2,851 (excluding the shooters). 135 incidents met "mass killing" definition (3 or more killings in a single incident). Killed: 1,062 (including 1,023 civilians, 29 law enforcement officers and 10 security guards). Wounded: 1,789 (including 1,703 civilians, 80 law enforcement officers, and 6 security guards). Number of shooters: 345 (16 wore body armor). Shooter gender: 332 male, 13 female. 119 shooters committed suicide (113 male, 6 female). Other shooter outcomes: 67 killed by police, 4 killed by citizens, 150 apprehended by police, 4 at large.

Active Shooter Incidents 20-Year Review, 2000-2019 4

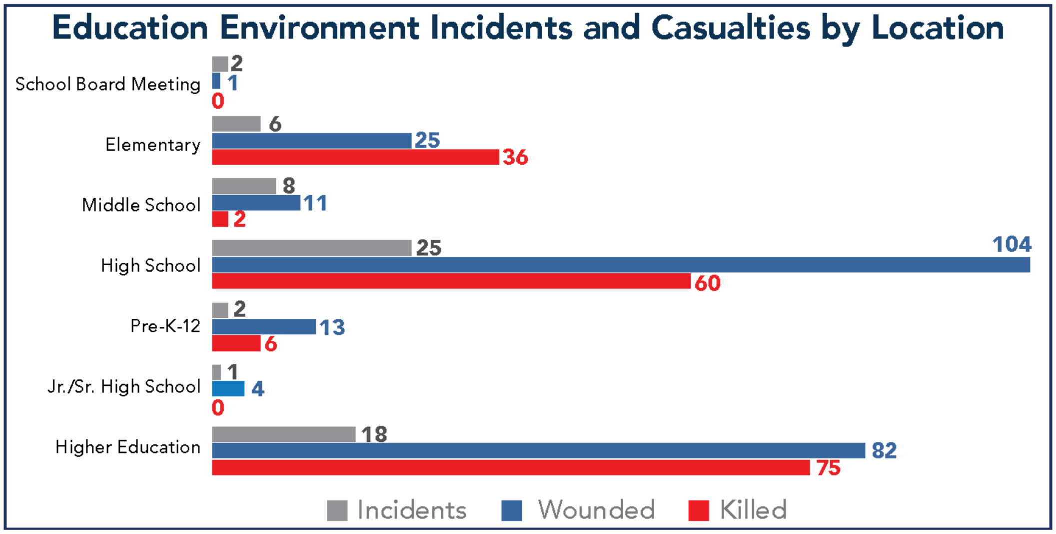
Figure 43 - Education Environments

ACTIVE SHOOTER INCIDENTS

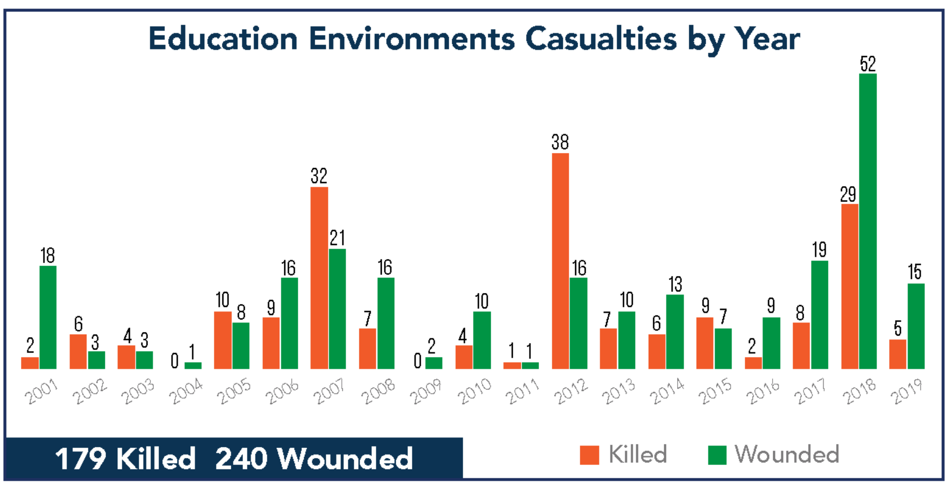
Education Environments

Quick Look:

Sixty-two incidents occurred in public and private educational settings, defined as schools covering pre-kindergarten to 12th grade, institutes of higher education, and school board meetings.



Education Environment Incidents and Casualties by Location: School Board Meeting (2 incidents, 1 wounded, 0 killed); Elementary (6 incidents, 25 wounded, 36 killed); Middle School (8 incidents, 11 wounded, 2 killed); High School (25 incidents, 104 wounded, 60 killed); Pre-K-12 (2 incidents, 13 wounded, 6 killed); Jr./Sr. High School (1 incident, 4 wounded, 0 killed); Higher Education (18 incidents, 82 wounded, 75 killed)



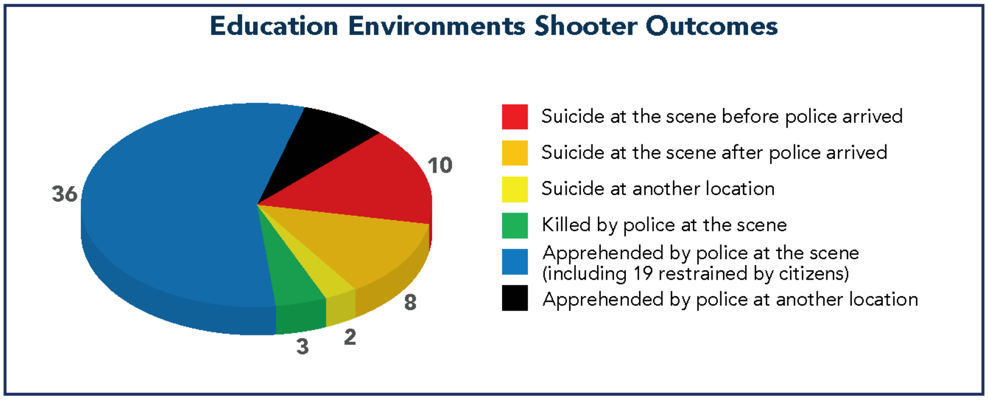
Education Environments Casualties by Year: 2001 (2 killed, 18 wounded); 2002 (6 killed, 3 wounded); 2003 (4 killed, 3 wounded); 2004 (0 killed, 1 wounded); 2005 (10 killed, 8 wounded); 2006 (9 killed, 16 wounded); 2007 (32 killed, 21 wounded); 2008 (7 killed, 16 wounded); 2009 (0 killed, 2 wounded); 2010 (4 killed, 10 wounded); 2011 (1 killed, 1 wounded); 2012 (38 killed, 16 wounded); 2013 (7 killed, 10 wounded); 2014 (6 killed, 13 wounded); 2015 (9 killed, 7 wounded); 2016 (2 killed, 9 wounded); 2017 (8 killed, 19 wounded); 2018 (29 killed, 52 wounded); 2019 (5 killed, 15 wounded)

Active Shooter Incidents 20-Year Review, 2000-2019 13

Figure 44 - Education Environments Cont'd

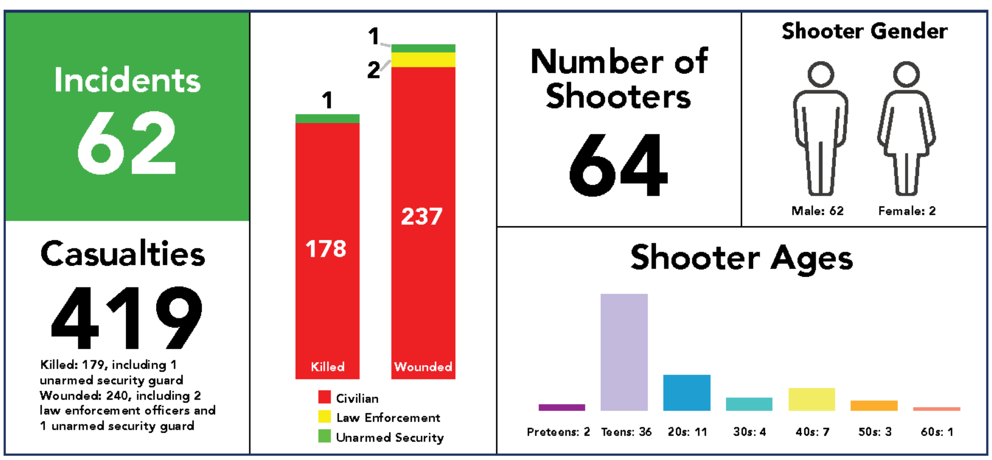
ACTIVE SHOOTER INCIDENTS

Education Environments



Education Environments Shooter Outcomes: Suicide at the scene before police arrived (10); Suicide at the scene after police arrived (8); Suicide at another location (2); Killed by police at the scene (3); Apprehended by police at the scene (including 19 restrained by citizens) (36); Apprehended by police at another location (5)

Key Findings:



Incidents: 62. Total casualties: 419. Killed: 179 (including 178 civilians and 1 unarmed security guard). Wounded: 240 (including 237 civilians, 2 law enforcement officers, and 1 unarmed security guard). Number of shooters: 64. Shooter gender: 62 male, 2 female. Shooter ages: Preteens (2); Teens (36); 20s (11); 30s (4); 40s (7); 50s (3); 60s (1).

Active Shooter Incidents 20-Year Review, 2000-2019 14

The complete report may be found here: https://www.fbi.gov/file-repository/active-shooter-incidents-20-year-review-2000-2019-060121.pdf/view.

Cyber-Threats

While Calvert County has not been the target of any critical cyber terrorist events, the county has seen multiple security breaches due to online phishing and other scams.

One hack attack took down the largest fuel pipeline in the U.S. and led to massive gasoline shortages; it was the result of a single compromised password. Hackers gained entry into the networks of Colonial Pipeline Company on April 29, 2021 through a virtual private network account, which allowed employees to remotely access the company's computer network. On May 7, 2021, a ransom of $4.4 million was demanded by the hackers, causing Colonial to shut down the entire supply line, immediately prompting temporary gasoline shortages and panic buying up and down the East Coast. The hackers, who were an affiliate of a Russian-linked cybercrime group known as *DarkSide*, were paid the ransom. The hackers also stole nearly 100 gigabytes of data from Colonial Pipeline and threatened to leak it if the ransom was not paid, according to Bloomberg News.

Then, in early June 2021, JBS, the world's largest meat company by sales, paid an $11 million ransom to cybercriminals who temporarily knocked out plants that process roughly one-fifth of the nation's meat supply. The ransom payment, in bitcoin, was made to shield JBS meat plants from further disruption and to limit the potential impact on restaurants, grocery stores and farmers that rely on JBS, according to the company.

The attack on JBS was part of a wave of incursions using ransomware, in which companies are hit with demands for multimillion-dollar payments to regain control of their operating systems. The attacks show how hackers have shifted from targeting data-rich companies such as retailers, banks and insurers to essential-service providers such as hospitals, transport operators and food companies.

4.3.22.4 Future Occurrence

The likelihood of Calvert County being a primary target for a major international terrorist attack is small and unlikely. More likely terrorist activity in Calvert County includes bomb threats or other incidents at schools. Calvert County has one school district consisting of twenty-three public schools. Several private schools and colleges/universities are also located in Calvert County. These locations are considered soft targets and may be vulnerable, especially to domestic incidents.

4.3.22.5 Vulnerability Assessment

Calvert County should stay prepared for terroristic events. The existence of industrial commerce, interstate highways and freight railroad activity create soft targets that could be used to interfere with the focus of day-to-day life that the county experiences. It is important to note that the use of and exposure to biological agents can remain unknown for several days until the infected person(s), livestock, or crops begin to experience symptoms or show damages. Often such agents are contagious, and the infected person(s) must be quarantined, livestock culled, and/or crops destroyed.

Although previous events have not resulted in what are considered to be significant terrorist attacks, the severity of a future incident cannot be predicted with a total level of certainty. One of the major concerns with agroterrorism is that acts can be carried out with minimal planning, effort, or expense.

Acronis, a global technology company that develops on-premises and cloud software for backup, disaster recovery, and secure file sync and share and data access, issues an annual threat scape report on cybercrime. Entitled *The Acronis Cyberthreats Report*, it contains an in-depth review of the current threat landscape and projections for the coming year. Based on the protection and security challenges that were amplified by the shift to remote work during the COVID-19 pandemic, Acronis warns aggressive cybercrime activities will continue as criminals pivot their attacks from data encryption to data exfiltration.

The major points illustrated in the report are as follows:

- Attacks against remote workers will increase due to the movement of workers to less secure working areas.
- Ransomware will look for new victims and will become more automated.
- Legacy IT and technical solutions will struggle to keep pace with ransomware and cybercrime attacks.

According to a study carried out on the data sourced from the Federal Bureau of Investigation, Maryland is ranked second worst among states when it comes to handling cyber-attacks. The study made by Information Network Associates – an international security consulting company – says an increase of 25% was witnessed in cyber-attacks between 2016 and 2017. This illustrates the amount of preparation that must occur in the state so that it can better respond to potential cybercrime attacks.

The probability of terrorist activity is more difficult to quantify than some other hazards. Instead of considering the likelihood of occurrence, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk terrorist targets in communities, planning efforts can be put in place to reduce the risk of attack. Planning should work towards identifying potentially at-risk critical infrastructure and functional needs facilities in the community, prioritizing those assets and locations, and identifying their vulnerabilities relative to known potential threats.

All communities in Calvert County are vulnerable on some level, directly or indirectly, to a terrorist attack. However, communities with schools and government infrastructure like the county seat, should be considered more likely to attract terrorist activity.

4.3.23. Transportation Accidents

4.3.23.1 Location and Extent

Transportation accidents are defined as accidents involving highway, air, and rail travel. These incidents are collectively the costliest of all hazards in the state in terms of lives lost, injuries, and economic losses. The sheer amount of roadway, coupled with the high volume of traffic, creates the potential for serious accidents along the roads and bridges. In Calvert County there are 403 state-maintained road segments and 3,271 locally maintained and owned road segments, according to the Maryland Department of Transportation (MDOT). Major transportation routes in Calvert County include Maryland Route 4, Maryland Route 2, Maryland Route 231 and Maryland Route 260. Other state routes are also present in the county including Maryland Route 263, Maryland Route 265, Maryland Route 402, and Maryland Route 765. *Figure 45 – Major Transportation Routes* shows the major transportation systems in Calvert County.

There are no public airports in Calvert County but there are three private airports listed within the county. These airports include the Chesapeake Ranch Airport, the Mears Creek Airfield, and the Sandy Point Airport. There are also two private helipads in Calvert County, one located at the CalvertHealth Medical Center, and one located at the Cove Point Liquid Natural Gas facility. There exists a potential extent for air transportation accidents to occur due to the number of commercial air traffic that flyovers the county every day. However, a two-mile radius around each airport can be considered a high-risk area since most aviation incidents occur near take-off and landing sites. This information can be found in *Figure 46 – Airports and Vulnerability Zones*.

There are no oil and gas wells located in Calvert County. Pipeline infrastructure is seen throughout the county and the Cove Point Liquid Natural Gas plant is operated by Berkshire Hathaway.

4.3.23.2 Range of Magnitude

Significant passenger vehicle, air, and rail transportation accidents can result in a wide range of outcomes from damage solely to property to serious injury or even death. The majority of motor vehicle crashes in Maryland are non-fatal, but MDOT estimates that every hour nine people are injured in a car crash, and every seven hours someone dies as a result of a car crash. Most fatal crashes occur in May and June, but the highest number of crashes overall occur in October, November, and December. Inclement weather and higher traffic volumes and speeds increase the risk for automobile accidents.

Railway and roadway accidents have the potential to result in hazardous materials release. Railroad accidents occur with less frequency than highway accidents. However, when these types of incidents occur, they often cause extensive property damage and have the potential to cause serious injuries or deaths.

The worst-case scenario for a transportation accident impacting the county would be a road accident which results in a hazardous material spill in any of the Town Centers including along Maryland Route 4, the major north-south route in the county. Depending on the result of said accident, major transportation from the northern areas of the county to the southern areas of the county could be extremely difficult to impossible. Such an event would constitute an immediate health hazard to the population and require evacuation.

4.3.23.3 Past Occurrence

Table 70 – MDOT Crash Report for Calvert County shows crash statistics recorded by the Maryland Department of Transportation between 2017 and 2021. Data for 2022 was not published and data for 2023 is in progress. Reports for 2022 and 2023 were not available at the time of this report. The year 2018 had the most total crashes in Calvert County while 2020 had the least total crashes. The number of total crashes has declined over the span of five years between 2017 and 2021 in the county. The number of pedestrian related incidents in Calvert County, when considered with transportation accidents, has remained relatively steady over the past five years. There was a total of fourteen reported pedestrian incidents in Calvert County in 2017 and a total of fourteen pedestrian incidents in Calvert County in 2021. However, the number of pedestrian fatalities has decreased over five years.

Table 70 - MDOT Crash Report for Calvert County

MDOT Crash Report for Calvert County							
Year	Vehicle accidents for Calvert County				Pedestrian Information		
	Total	Fatal Accidents	Injury Crashes	Property Damage Only	Pedestrian Fatalities	Pedestrian Injuries	Total
2017	1,212	9	407	796	3	11	14
2018	1,255	5	366	884	0	17	17
2019	1,124	6	347	771	1	12	13
2020	956	10	275	671	2	12	14
2021	1,027	8	299	720	0	14	14
Source: MDOT, 2023							

In 2021, there was only one fatal accident in Calvert County related to drugs or alcohol. There were twenty-six crashes involving drugs or alcohol that resulted in only injuries in Calvert County in 2021, and 125 accidents involving drugs or alcohol that resulted in property damage only. More information on crash statistics in the state of Maryland as a whole can be found on the Zero Deaths Maryland webpage, by the Maryland Government at the following file path: https://zerodeathsmd.gov/

4.3.23.4 Future Occurrence

Calvert County's population has increased over the last decade, so it can be assumed that local traffic has increased slightly as well. With the increasing volume of goods and trucking through the county, transportation accidents will continue to occur routinely. Hazardous material release through transportation accidents is difficult to predict but can be assumed to happen in future events as well. The U.S. Census Bureau reports the mean travel time to work for those aged 16 plus is approximately twenty-four minutes. Automobile accidents occur frequently, and typically occur more frequently than rail or aviation accidents. In the case of highway accidents, MDOT has taken great strides to reduce the number of highway transportation accidents through programs. Transportation accidents are impossible to predict accurately; however, areas prone to these hazards can be located, quantified through analysis of historical records, and plotted on countywide and municipal base maps.

4.3.23.5 Vulnerability Assessment

A transportation accident can occur anywhere in Calvert County. However, severe accidents are more likely to occur on the county's major highways due to the heavier traffic volumes which make highways extremely vulnerable. The vulnerability for accidents on either highway, railway, or aviation, are directly related to the population and traffic density within the county. The vulnerability increases if there are hazardous materials involved. Hazards associated with causing transportation accidents can include natural hazards that affect the environment, such as winter storms or heavy rains that cause slippery roadways or mud slides, to windstorms or tornadoes that cause high-profile vehicles or train cars to topple over. Loss of roadway use, and public transportation services would affect commuters, employment, delivery of critical municipal and emergency services, and day-to-day operations within the county.

With highway accidents, there is an added vulnerability that stems from the age and upkeep of bridges throughout the county. Unrepaired, deficient bridges may be more likely to break, thus leading to highway transportation damages or deaths. Approximately 50% of Calvert County bridges are in need of infrastructure inspection and refurbishment, indicating an increased vulnerability to transportation accidents, while 50% remain in fair condition. Of particular concern for inspection are the major bridges that transport traffic into and out of Calvert County including the Governor Thomas Johnson Bridge between Calvert County and California, MD and the Benedict Bridge between Calvert County and Hughesville, MD.

Calvert County has a unique situation in the roadways that lead into and out of the county. As Calvert County is a peninsula between the Patuxent River and the Chesapeake Bay, bridges are the main throughfares for the county. An accident on any of these bridges that would result in the closure of a bridge would significantly impact the availability of travel and travel times into and out of Calvert County. When transportation accidents and their impacts are viewed as a cascading problem from major natural hazards, this becomes a significant vulnerability for Calvert County.

Studying traffic and potential transportation accident patterns could provide information on vulnerability of specific road segments and nearby populations. Increased understanding of the types of hazardous materials transported through the county will also support mitigation efforts. Maintaining a record of these frequently transported materials can facilitate development of preparatory measures for response to a release. *Figure 47– Average Daily Traffic on Major Highway Vulnerability* identifies all major highways and railroads within Calvert County.

Figure 45 - Major Transportation Routes

Figure 46 - Airports and Vulnerability Zones

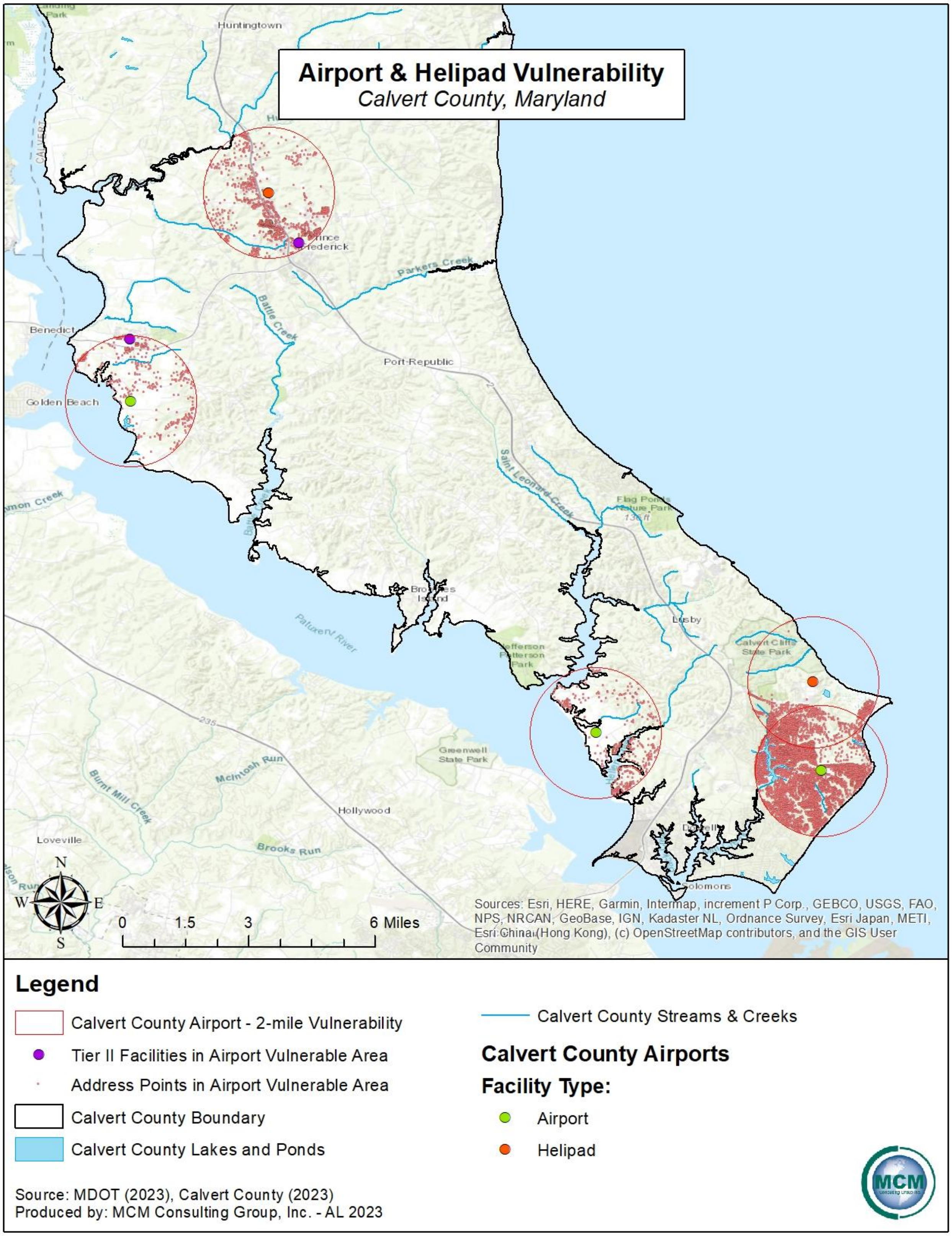
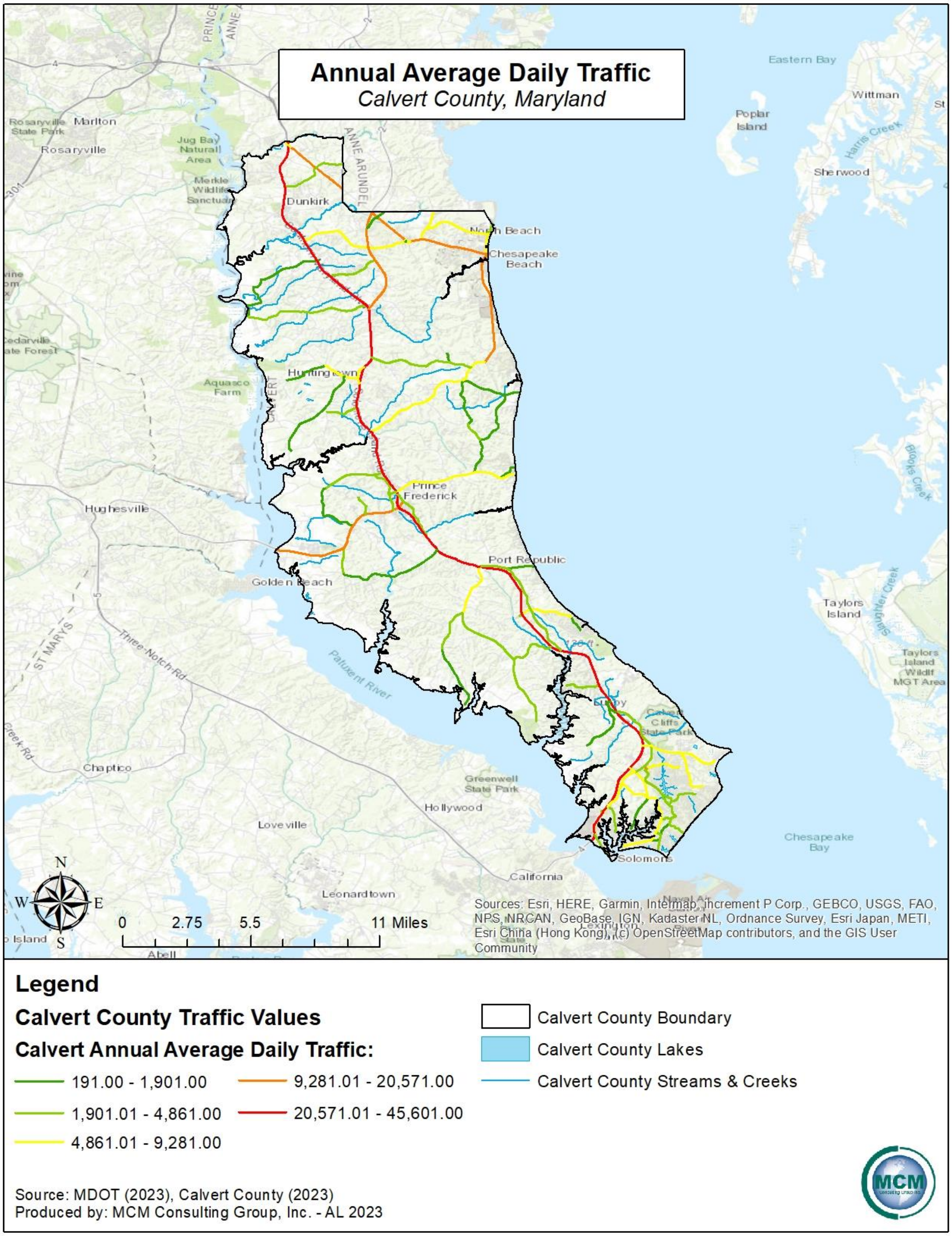


Figure 47 - Average Daily Traffic on Major Highway Vulnerability



4.3.24. Utility Interruptions

4.3.24.1 Location and Extent

Utility interruptions can occur from an internal system failure or as a secondary impact of another hazard, such as windstorm, winter storm, extreme temperatures, or a traffic accident. Strong adverse weather conditions and storms can cause widespread disruptions in electric and telecommunications service due to power lines being brought down by falling tree branches across a region. Strong heat waves may result in rolling blackouts where power may not be available for an extended period, impacting air conditioning across a region. Space weather, specifically solar flares, can also pose a threat to utility service across the globe. Although uncommon, the northeastern seaboard and the north central regions of the United States are particularly susceptible to this hazard.

The age of utility infrastructure also plays a role in interruptions, causing longer periods of outages in a larger area. Natural gas, water, telecommunications, and electric capabilities can all experience disruptions. Worker strikes at power generation facilities have also been known to cause minor and temporary power outages and failures. Other causes for minor power outages include but are not limited to vehicle accidents and wire destruction due to animals or wildlife. Outages can also be caused by blown transformers or tripped circuit breakers in the electric system. Major power outages typically occur on a regional scale and can last both short term and long term.

The list of utility providers in Calvert County is shown in *Table 71 – Calvert County Utility Providers*.

Table 71 - Calvert County Utility Providers

Calvert County Utility Providers	
Utility Type	**Name of Utility Provider**
Electricity	Southern Maryland Electric Cooperative (SMECO), Calvert Cliffs Nuclear Power Plant, Baltimore Gas and Electric
Telephone/9-1-1/Wireless	Verizon, T-Mobile, AT&T, Jade Connections
Natural Gas	Cove Point LNG, Aero Energy, SJ Johnson Inc, Suburban Propane
Water	Calvert County Water and Sewer Division, Beaches Water Company Inc, Chesapeake Ranch Water Company
Source: MD Public Utility Commission, 2022	

4.3.24.2 Range of Magnitude

Utility interruptions do not typically lead to large-scale problems by themselves. Typically, human casualties are not a direct result from outages. Many utility interruptions occur during storms or other severe weather events, and they can have secondary consequences. Typical secondary effects from a power outage can include a delay in emergency response and those services arriving in timely manner. A lack of potable drinking water can also become a major issue for areas impacted by utility interruptions.

Electricity:

Interruptions or power failures could have the following impacts:

- Public safety concerns
- Food spoilage
- Loss of heating or air conditioning
- Basement flooding due to sump pump failure
- Loss of indoor lighting
- Loss of internet service
- Stopped and stalled elevators
- Direct economic impact from retail settings

Of all the above-listed impacts, the loss of heating or air conditioning poses the greatest risk to the elderly and very young populations during times of extreme temperature. Prolonged power outages also pose a risk to residents that rely on home-based medical equipment such as home-supply oxygen units. Some of the issues that are listed above can be considered more of a nuisance than a hazard, such as food spoilage due to long-term electrical outages. However, significant damage or harm can occur depending on the population affected, the duration, and the severity of the outage.

A worst-case scenario for the utility interruptions would be a county-wide power outage during winter months, forcing the evacuation of vulnerable populations to facilities outside of the county or to warming shelters within the county.

Fuel:

Interruptions of the transportation of gas and other products used for fuel can lead to a loss of heating and manufacturing capabilities. This can adversely affect the economic stability of a region and the production of needed products for consumption.

Telecommunications:

Interruptions to telecommunications systems include impacts to the 9-1-1 capabilities of a region, telephone, and internet service. The greatest risk in losing this utility to interruption is the risk of an emergency not being able to be reported to a public safety answering point (PSAP). Extensive loss of telephone and internet service can be detrimental to government, businesses, and to residents. With much of the country now dependent on wireless networks, signal interruptions can cause a large issue for people who are utilizing wireless telecommunications for work. There are also many concerns regarding safety and internet security due to the increase in people working over wireless networks that occurred during the COVID-19 pandemic. These interruptions and issues can be detrimental for the Calvert County workforce.

4.3.24.3 Past Occurrence

Minor utility interruptions occur annually in Calvert County and occur most often in conjunction with winter weather and/or windstorms. Calvert County can expect to have power outages and phone outages each year.

The state of Maryland maintains power outage data that at any time is only two weeks old. At the time of this writing, Calvert County had approximately 11,522 customers who were out of power from July 5th, 2023 to July 19th, 2023. Information for older events was not available from the state of Maryland. The information that is available is provided by utility providers on a rolling basis.

Other past significant events of utility interruptions in the United States occur on a regional basis and can have varied effects related to number of impacted customers. A large water treatment plant failure occurred in Jackson, Mississippi in August of 2022 after flooding impacted the treatment facility. The city of Jackson was left without safe drinking water for close to two months until the water was deemed safe and potable in October of 2022. This event stood out as a large scale failure of community lifelines and utilities. This event also opened discussions related to equity in infrastructure repairs, as the repairs took a significant amount of time in a vulnerable socio-economic area. An attack on an electrical grid and power substations in North Carolina in December of 2022 left almost 45,000 people without power and reliant heat during the cold temperatures of January.

4.3.24.4 Future Occurrence

Utility Interruptions are difficult to predict, and minor interruptions may occur several times a year to all utilities. Even so, utility interruptions occur more frequently as a secondary factor to severe weather events or transportation accidents.

Space weather is getting more attention as an infrastructure risk due in part to a March 2020 report by the United States Geological Survey (USGS). The report noted that geomagnetic storms caused by the dynamic action of the Sun and solar wind on the space environment surrounding the Earth can generate electric fields in the Earth's crust and mantle. These electric fields can interfere with the operation of grounded electric power-grid systems. Geomagnetic storms occur only occasionally, but when sufficiently energetic they can produce blackouts on a large scale.

As utility infrastructure ages, interruption events could occur more frequently if the maintenance of the infrastructure is not maintained. Utility providers can reduce Calvert County's vulnerability to power outages by implementing improvement plans for utility infrastructure.

Total replacement is not a feasible solution to the issue, but compromises can be reached to ensure that the new and old equipment along a utility line can work together efficiently.

4.3.24.5 Vulnerability Assessment

Resources such as electricity, communications, gas, and water supply are critical to ensure the health, safety, and general welfare of the citizenry.

Power outages can cause even greater detriment to at-risk and vulnerable populations, such as elderly (e.g., supplemental oxygen power needs) or those with functional and access needs to consider. All critical infrastructure is vulnerable to the effects of a power surge. The probability of a large-scale, extended utility failure is low; however, small-scale failures lasting short periods of time occur annually.

Long-term care facilities, senior centers, hospitals, and emergency medical facilities are all vulnerable to utility interruptions. Often back-up power generators are used at these facilities to offset electrical needs during extreme hot or cold temperature events. However, these back-up power generators must be maintained, and fuel supplies must be secured in advance of the utility interruption to ensure a seamless transition from the everyday, grid power source to the emergency generator. When officials consider maintenance and supplies for a facility, long-term use of back-up generators should be planned.

<u>Electricity:</u>

Severe weather is one of the largest causes of power loss. The electric power grid infrastructure can be damaged by snow, ice, high winds, lightning, flooding, falling tree limbs, and vehicle accidents involving utility poles. Small animals can also cause minor power outages by climbing along the lines and shorting out the system.

Causes of a regional scale power outage or failure could be from infrastructure failure, sabotage, human error, or worker strikes. Community lifeline facilities are vulnerable to utility interruptions, especially the loss of power. The establishment of reliable backup power at these facilities is extremely important to provide continued support of the health, safety, and well-being of Calvert County residents and visitors.

The occurrence of severe weather-related utility interruptions will increase due to climate change in the State of Maryland and the United States as a whole. Climate change will cause weather to become more severe on a more frequent basis.

<u>Water:</u>

Water distribution can be affected in three ways.

- The amount of water available (depends on nature)
- The quality of the water (depends on human responsibility)
- The viability of the physical components of the distribution system

Well contamination or water shortages due to drought could pose a high vulnerability to local water distribution. Drought events will continue to occur more frequently as climate change alters the available amount of ground water for consumption. This will result in greater well shortages and water utility interruptions for citizens that have well water.

Water contamination can occur naturally, by human error, or intentionally. Releases of manure and milk into the water supply can cause contamination. Overflows from sewage systems and lagoons on farms can also cause contamination of groundwater and drinking water. There are times when accidental spills and releases of hazardous materials contaminate water supplies, thereby, water supplies along transportation routes may be affected.

<u>Gas and Liquid Pipelines:</u>

Interruptions to natural gas distribution lines could be affected by:

- Deterioration of line and facilities
- Puncturing the distribution lines by humans (either intentional or accidental)
- Coastal or winter storms
- Extreme heat or cold events
- Transportation accidents

<u>Communications:</u>

Interruptions in communications could be caused as a secondary effect of storms or high winds, infrastructure failure, or by humans (intentional or accidental). A loss of communications by emergency services would be devastating to the population of Calvert County 9-1-1 calls could not be received, or if emergency units could not be dispatched properly and/or timely.

No data regarding economic impacts from utility interruptions in Calvert County are available. However, utility interruptions can cause economic impacts stemming from lost income, spoiled food and other goods, costs to the owners or operators of the utility facilities, and costs to government and community service groups.

4.4. Hazard Vulnerability Summary

4.4.1. Methodology

Ranking hazards helps communities set goals and priorities for mitigation based on their vulnerabilities. A risk factor (RF) is a tool used to measure the degree of risk for identified hazards in a particular planning area. The RF can also assist local community officials in ranking and prioritizing hazards that pose the most significant threat to a planning area based on a variety of factors deemed important by the planning team and other stakeholders involved in the hazard mitigation planning process. The RF system relies mainly on historical data, local knowledge, general consensus from the planning team and information collected through development of the hazard profiles included in Section 4.3. The RF approach produces numerical values that allow identified hazards to be ranked against one another; the higher the RF value, the greater the hazard risk.

RF values were obtained by assigning varying degrees of risk to five categories for each of the hazards profiled in the HMP update. Those categories include *probability*, *impact*, *spatial extent*, *warning time and duration*. Each degree of risk was assigned a value ranging from one to four. The weighting factor agreed upon by the planning team is shown in *Table 72 – Risk Factor Approach Equation* To calculate the RF value for a given hazard, the assigned risk value for each category was multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the following example equation:

Table 72 - Risk Factor Approach Equation

Risk Factor Value =
[(Probability x .30) + (Impact x .30) +(Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]

Table 73 – Risk Factor Approach Summary summarizes each of the five categories used for calculating a RF for each hazard. According to the weighting scheme applied, the highest possible RF value is 4.0.

Table 73 - Risk Factor Approach Summary

Summary of Risk Factor Approach Used to Rank Hazard Risk.				
RISK ASSESSMENT CATEGORY	DEGREE OF RISK			WEIGHT VALUE
	LEVEL	CRITERIA	INDEX	
PROBABILITY *What is the likelihood of a hazard event occurring in a given year?*	**UNLIKELY**	LESS THAN 1% ANNUAL PROBABILITY	1	30%
	POSSIBLE	BETWEEN 1 & 10% ANNUAL PROBABILITY	2	
	LIKELY	BETWEEN 10 &100% ANNUAL PROBABILITY	3	
	HIGHLY LIKELY	100% ANNUAL PROBABILTY	4	
IMPACT *In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?*	**MINOR**	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.	1	30%
	LIMITED	MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE DAY.	2	
	CRITICAL	MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE WEEK.	3	
	CATASTROPHIC	HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR 30 DAYS OR MORE.	4	
SPATIAL EXTENT *How large of an area could be impacted by a hazard event? Are impacts localized or regional?*	**NEGLIGIBLE**	LESS THAN 1% OF AREA AFFECTED	1	20%
	SMALL	BETWEEN 1 & 10% OF AREA AFFECTED	2	
	MODERATE	BETWEEN 10 & 50% OF AREA AFFECTED	3	
	LARGE	BETWEEN 50 & 100% OF AREA AFFECTED	4	
WARNING TIME *Is there usually some lead time associated with the hazard event? Have warning measures been implemented?*	**MORE THAN 24 HRS**	SELF-DEFINED *(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)*	1	10%
	12 TO 24 HRS	SELF-DEFINED	2	
	6 TO 12 HRS	SELF-DEFINED	3	
	LESS THAN 6 HRS	SELF-DEFINED	4	
DURATION *How long does the hazard event usually last?*	**LESS THAN 6 HRS**	SELF-DEFINED *(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)*	1	10%
	LESS THAN 24 HRS	SELF-DEFINED	2	
	LESS THAN 1 WEEK	SELF-DEFINED	3	
	MORE THAN 1 WEEK	SELF-DEFINED	4	

4.4.2. Ranking Results

Using the methodology described in Section 4.4.1, *Table 74 – Risk Factor Assessment* lists the risk factor calculated for each of twenty-eight potential hazards identified in the 2023 HMP. Hazards identified as *high* risk have risk factors greater than 2.5. Risk factors ranging from 2.0 to 2.4 were deemed *moderate* risk hazards. Hazards with risk factors 1.9 and less are considered *low* risk.

Table 74 - Risk Factor Assessment

Calvert County Hazard Ranking Based on RF Methodology.							
HAZARD RISK	HAZARD NATURAL(N) OR HUMAN-CAUSED (H)	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	ECONOMIC IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
HIGH	Emergency Services	4	3	4	1	4	**3.4**
	Pandemic, Epidemic, and Infectious Disease	4	2	4	1	4	**3.1**
	Opioid Epidemic	3	3	4	1	4	**3.1**
	Extreme Temperatures	4	2	4	1	3	**3.0**
	Winter Storm	3	3	4	1	3	**3.0**
	Landslide (Including cliff erosion)	4	3	2	4	1	**3.0**
	Coastal Erosion (Excluding cliff erosion)	4	2	3	1	4	**2.9**
	Hurricane and Tropical Storms	2	4	4	1	2	**2.9**
	Radon Exposure	4	2	3	1	4	**2.9**
	Drought	3	2	4	1	4	**2.8**
	Invasive Species	4	1	4	1	4	**2.8**
	Land Subsidence	4	1	4	1	4	**2.8**
	Environmental Hazards (Transportation)	2	3	3	4	3	**2.8**
	Cyberterrorism	3	2	3	4	3	**2.8**
	Utility Interruptions	3	2	2	4	2	**2.8**
	Flooding (100-year)	4	2	1	4	1	**2.6**
	Terrorism	3	2	3	2	1	**2.5**
	Transportation Accidents	2	2	3	3	1	**2.5**
MODERATE	Tornado and Windstorm	2	2	3	3	1	**2.4**
	Environmental Hazards (Fixed Facility)	1	2	3	3	3	**2.3**
	Flash Flooding	1	1	4	4	1	**2.2**
	Hail	2	1	1	4	1	**2.2**
	Nuclear Incidents	1	1	1	4	1	**2.1**

Calvert County Hazard Ranking Based on RF Methodology.							
HAZARD RISK	HAZARD NATURAL(N) OR HUMAN-CAUSED (H)	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	ECONOMIC IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
LOW	Nuisance Flooding	1	1	1	4	1	**1.9**
	Earthquake	4	3	4	1	4	**1.9**
	Wildfire	4	2	4	1	4	**1.6**
	Civil Disturbance	3	3	4	1	4	**1.3**
	Dam Failure	4	2	4	1	3	**1.3**

Based on these results, there are eighteen high risk hazards, five moderate risk hazards, and five low risk hazards in Calvert County. Mitigation actions were developed for all high, moderate, and low risk hazards (see section 6.4). The threat posed to life and property for moderate and high-risk hazards is considered significant enough to warrant the need for establishing hazard-specific mitigation actions. Mitigation actions related to future public outreach and emergency service activities are identified to address low risk hazard events.

A risk assessment result for the entire county does not mean that each municipality is at the same amount of risk to each hazard. *Table 75 – Countywide Risk Factor Assessment* shows the different municipalities in Calvert County and whether their risk is greater than (>), less than (<), or equal to (=) the risk factor assigned to the county as a whole. This table was developed by the consultant based on the findings in the hazard profiles located in sections 4.3.1 through 4.3.24.

Table 75 - Countywide Risk Factor

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Emergency Services	Pandemic, Epidemic, and Infectious Disease	Opioid Epidemic	Extreme Temperatures	Winter Storm	Landslide	Coastal Erosion	Hurricane and Tropical Storm	Radon Exposure
	3.4	3.1	3.1	3.0	3.0	3.0	2.9	2.9	2.9
Chesapeake Beach, Town	=								
North Beach, Town	=								

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Drought	Invasive Species	Land Subsidence	Environmental Hazards (Transportation)	Cyberterrorism	Utility Interruptions	Flooding (100-year)	Terrorism	Transportation Accidents
	2.8	2.8	2.8	2.8	2.8	2.8	2.6	2.5	2.5
Chesapeake Beach, Town	=								
North Beach, Town	=								

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk										
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR										
JURISDICTION	Tornado and Windstorm	Environmental Hazards (Fixed Facility)	Flash Flooding	Hail	Nuclear Incidents	Nuisance Flooding	Earthquake	Wildfire	Civil Disturbance	Dam Failure
	2.4	2.3	2.2	2.2	2.1	1.9	1.9	1.6	1.3	1.3
Chesapeake Beach, Town	=									
North Beach, Town	=									

4.4.3. Potential Loss Estimates

Based on various kinds of available data, potential loss estimates were established for flooding. Estimates provided in this section are based on HAZUS-MH, version MR4, geospatial analysis, and previous events. Estimates are considered *potential* in that they generally represent losses that could occur in a countywide hazard scenario. In events that are localized, losses may be lower, while regional events could yield higher losses.

Potential loss estimates have four basic components, including:

Replacement Value: Current cost of returning an asset to its pre-damaged condition, using present-day cost of labor and materials.
Content Loss: Value of building's contents, typically measured as a percentage of the building replacement value.
Functional Loss: The value of a building's use or function that would be lost if it were damaged or closed.
Displacement Cost: The dollar amount required for relocation of the function (business or service) to another structure following a hazard event.

Flooding Loss Estimation:

Flooding is a high-risk natural hazard in Calvert County. The estimation of potential loss in this assessment focuses on the monetary damage that could result from flooding. The potential property loss was determined for each municipality and for the entire county. The quantity of commercial and residential structures in each Calvert County municipality is outlined in section 4.3.5 of the flooding hazard profile.

MCM Consulting Group, Inc. conducted a countywide flood study using the Hazards U.S. Multi-Hazard (HAZUS-MH) software that is provided by the Federal Emergency Management Agency. This software is a standardized loss estimation software deriving economic loss, building damage, content damage and other economic impacts that can be used in local flood mitigation planning activities.

Using HAZUS-MH, total building-related losses from a 1%-annual-chance flood in Calvert County are estimated to equal $84.6 million with 93% of that coming from residential homes. Total economic loss, including replacement value, content loss, functional loss, and displacement cost, from a countywide 1%-annual-chance flood are estimated to equal $126.75 million.

4.4.4. Future Development and Vulnerability

The 2020 census population for Calvert County is 92,783 which is 4,046 increase from the 2010 census. There was an overall increase of 4.56% in population based on the data. Both the Town of Chesapeake Beach and the Town of North Beach municipalities have seen population increases while the Town Center of Dunkirk and the Town Center of Owings have seen a decrease in the period between 2010 and the 2020.

Table 76 - 2010-2020 Population Change

Population Change in Calvert County 2010 - 2020				
Municipality or Town Center	**2010 Census**	**2020 Census**	**Change**	**Percent of Change 2010 - 2020**
Municipality				
Town of Chesapeake Beach	5,753	6,356	603	10.48%
Town of North Beach	1,978	2,146	168	8.49%
Town Centers				
Dunkirk	2,521	2,431	-90	-3.57%
Huntingtown	3,311	3,545	234	7.07%
Lusby	1,835	2,072	237	12.92%
Owings	2,149	2,141	-8	0.37%
Prince Frederick (County Seat)	2,538	3,226	688	27.11
St. Leonard	742	778	36	4.85
Solomons	2,368	2,650	282	11.91
Entire County				
Calvert County	*88,737*	*92,783*	*4,046*	*4.55%*
Source: United States Census Bureau, 2010 and 2020				

The 2019 census estimates indicate that there are approximately 35,501 housing units in Calvert County, Maryland. Of those, 92.3% of the structures are occupied-housing units. The county-wide population changes indicate a potential alteration to overall hazard vulnerability.

Municipalities that undergo widespread population reductions may have more difficulty meeting personnel demands than expanding jurisdictions. However, certain municipalities experienced significant resident increases and, thus, may be more vulnerable to certain hazards due to development and residential growth. Although expanding population zones may be especially vulnerable to hazards outlined in section 4.3 of this hazard mitigation plan update, natural and human caused hazards could potentially occur at any time regardless of population change. The Calvert County Hazard Mitigation Local Planning Team will conduct annual reviews of this plan or review the plan on a county timeline and will review the impacts all hazards have on the county and new development. A review will also be conducted within a time frame after a disaster or major emergency.

5. Capability Assessment

5.1. Update Process Summary

The capability assessment is an evaluation of Calvert County 's governmental structure, political framework, legal jurisdiction, fiscal status, policies and programs, regulations, ordinances, and resource availability. Each category is evaluated for its strengths and weaknesses in responding to, preparing for, and mitigating the effects of the profiled hazards. A capability assessment is an integral part of the hazard mitigation planning process. Here, the county and municipalities identify, review, and analyze what they are currently doing to reduce losses and identify the framework necessary to implement new mitigation actions. This information will help the county and municipalities evaluate alternative mitigation actions and address shortfalls in the mitigation plan.

A capabilities assessment survey was provided to the municipalities during the planning process at meetings held with Calvert County officials. These meetings were designed to seek input from the key county and municipal stakeholders on legal, fiscal, technical, and administrative capabilities of all jurisdictions. As such, the capabilities assessment helps guide the implementation of mitigation projects and will help evaluate the effectiveness of existing mitigation measures, policies, plans, practices, and programs.

Throughout the planning process, the mitigation local planning team considered the county's two municipalities and many Town Centers. Maryland municipalities have their own governing bodies, pass, and enforce their own ordinances and regulations, purchase equipment and manage their own resources, including critical infrastructure. Therefore, these capability assessments consider the various characteristics and capabilities of municipalities under study.

The evaluation of the following categories – political framework, legal jurisdictions, fiscal status, policies and programs and regulations and ordinances – allows the mitigation planning team to determine the viability of certain mitigation actions. The capability assessment analyzes what Calvert County, and its municipalities have the capacity to do and provides an understanding of what must be changed to mitigate loss.

Calvert County has several resources it can access to implement hazard mitigation initiatives including emergency response measures, local planning and regulatory tools, administrative assistance and technical expertise, fiscal capabilities and participation in local, regional state, and federal programs. The presence of these resources enables community resiliency through actions taken before, during and after a hazardous event. While the capability assessment serves as a good instrument for identifying local capabilities, it also provides a means for recognizing gaps and weaknesses that can be resolved through future mitigation actions. The results of this assessment lend critical information for developing an effective mitigation strategy.

5.2. Capability Assessment Findings

Both of the municipalities in Calvert County completed and submitted a capability assessment survey. The results of the survey were collected, aggregated, and analyzed.

Each plan participant has some ability to expand and improve upon their administrative and technical capabilities following this plan update and during an update process. The municipalities of Calvert County could improve upon these capabilities by first reviewing the capability assessment forms submitted during this update process and identifying areas of growth based off these forms. A comprehensive review is within the power of each municipality of Calvert County to see what departments, commissions, boards, and staff they have available to assist in each aspect of capability assessments. Each municipality, as a plan participant, should assess if they have the ability to improve in these areas during an annual review process or during the next hazard mitigation plan update. The plan participants should also review their ability to improve the financial capabilities by reviewing funding and funding sources, and researching other funding sources for hazard mitigation processes. Each plan participant can improve their education and outreach capabilities by increasing public event participation and education events that they attend in the county.

5.2.1. Planning and Regulatory Capability

Municipalities have the authority to govern more restrictively than state and county minimum requirements as long as they are compliant with all criteria established in the Maryland state codes and requirements. Municipalities can develop their own policies and programs and implement their own rules and regulations to protect and serve their residents. Local policies and programs are typically identified in a comprehensive plan, implemented through a local ordinance, and enforced by the governmental body or its appointee.

Municipalities regulate land use via the adoption and enforcement of zoning, subdivision, land development, building codes, building permits, floodplain management and/or stormwater management ordinances. When effectively prepared and administered, these regulations can lead to an opportunity for hazard mitigation. For example, the National Flood Insurance Program (NFIP) established minimum floodplain management criteria, and adoption of the Maryland Model Floodplain Management Ordinance (FPMO) established even higher floodplain management standards. A municipality must adopt and enforce these minimum criteria to be eligible for participation in the NFIP. Municipalities have the option of adopting a single-purpose ordinance or incorporating these provisions into their zoning, subdivision, and land development, or building codes; thereby mitigating the potential impacts of local flooding. This capability assessment details the existing Calvert County and municipal legal capabilities to mitigate the profiled hazards. It identifies the county and the municipal existing planning documents and their hazard mitigation potential. Hazard mitigation recommendations are, in part, based on the information contained in the assessment.

Building Codes

Building codes are important in mitigation because they are developed for a region of the country in respect to the hazards that exist in that area. Consequently, structures that are built according to applicable codes are inherently resistant to many hazards, such as intense winds, floods, and earthquakes; and can help mitigate regional hazards, such as wildfires. Maryland implemented the Maryland Building Performance Standards (MBPS) (CO MAR 09.12.51), a comprehensive building code that establishes minimum regulations for most new construction, including additions and renovations to existing structures.

The code applies to almost all buildings, excluding manufactured and industrialized housing (which are covered by other laws), agricultural buildings, and certain utility and miscellaneous buildings. The UCC requires builders to use materials and methods that have been professionally evaluated for quality and safety, as well as inspections to ensure compliance.

The municipalities in Calvert County adhere to the standards of the Maryland Building Performance Standards. Both of the municipalities in Calvert County have opted-in on building code enforcement, although all municipalities enforce their own code enforcement.

Zoning Ordinance

Article VI of the Municipalities Planning Code (MPC) authorizes municipalities to prepare and enact zoning to regulate land use. Its regulations can apply to the permitted use of land, the height and bulk of structures, the percentage of a lot that may be occupied by buildings and other impervious surfaces, yard setbacks, the density of development, the height and size of signs, and the parking regulations. A zoning ordinance has two parts, including the zoning map that delineates zoning districts and the text that sets forth the regulations that apply to each district.

Subdivision Ordinance

Subdivision and land development ordinances include regulations to control the layout of streets, the planning lots and the provision of utilities and other site improvements. The objectives of subdivision and land development ordinance are to coordinate street patterns, to assure adequate utilities and other improvements are provided in a manner that will not pollute streams, wells and/or soils, to reduce traffic congestions, and to provide sound design standards as a guide to developers, the elected officials, planning commissions, and other municipal officials. Article V of the Municipality Planning Code authorizes municipalities to prepare and enact a subdivision and land development ordinance. Subdivision and land development ordinances provide for the division and improvement of land. Both incorporated municipalities in Calvert County have subdivision/land use ordinances, or have zoning regulations in place to address land development (Calvert County Office of Planning & Zoning, June 2023).

Stormwater Management Plan/Stormwater Ordinance

The proper management of storm water runoff can improve conditions and decrease the chance of flooding. Maryland's Storm Water Management Act confers on counties the responsibility for development of watershed plans. The Act specifies that counties must complete their watershed storm water plans within two years following the promulgation of these guidelines by the Maryland Department of the Environmental, which may grant an extension of time for any county for the preparation and adoption of plans. Counties must prepare the watershed plans in consultation with municipalities and residents. This is to be accomplished through the establishment of a watershed plan advisory committee. The counties must also establish a mechanism to periodically review and revise watershed plans. Plan revisions must be done every five years or sooner, if necessary.

Municipalities have an obligation to implement the criteria and standards developed in each watershed storm water management plan by amending or adopting laws and regulation for land use and development. The implementation of storm water management criteria and standards at the local level are necessary since municipalities are responsible for local land use decisions and planning. The degree of detail in the ordinance depends on the extent of existing and projected land development. The watershed storm water management plan is designed to aid the municipality in setting standards for the land uses it has proposed. Municipalities within rapidly developing watersheds will benefit from the watershed storm water management plan and will use the information for sound land use considerations. A major goal of the watershed plan and the attendant municipal regulations is to prevent future drainage problems and avoid the aggravation of existing problems. All municipalities in Calvert County have adopted the county's stormwater management plan.

Comprehensive Plan

A comprehensive plan is a policy document that states objectives and guides the future growth and physical development of a municipality. The comprehensive plan is a blueprint for housing, transportation, community facilities, utilities, and land use. It examines how the past led to the present and charts the community's future path.

Calvert County last updated its comprehensive plan in 2017. Both municipalities in Calvert County have their own comprehensive plans in place.

Capital Improvements Plan

The capital improvements plan is a multi-year policy guide that identifies needed capital projects and is used to coordinate the financing and timing of public improvements. Capital improvements relate to streets, storm water systems, water distribution, sewage treatment, and other major public facilities. A capital improvements plan should be prepared by the respective county's planning department and should include a capital budget. This budget identifies the highest priority projects recommended for funding in the next annual budget. The capital improvements plan is dynamic and can be tailored to specific circumstances.

Participation in the National Flood Insurance Program (NFIP)

Floodplain management is the operation of programs or activities that may consist of both corrective and preventative measures for reducing flood damage, including but not limited to such things as emergency preparedness plans, flood control works, and flood plain management regulations. The Maryland Model Floodplain Ordinance requires every municipality identified by the Federal Emergency Management Agency (FEMA) to participate in the National Flood Insurance Program and permits all municipalities to adopt floodplain management regulations. It is in the interest of all property owners in the floodplain to keep development and land usage within the scope of the floodplain regulations for their community. This helps keep insurance rates low and ensures that the risk of flood damage is not increased by property development.

These suggested or model ordinances contain provisions that are more restrictive than state and federal requirements. Suggested provisions include, but are not limited to, the below.

1. Prohibiting manufactured homes in the floodway
2. Prohibiting manufactured homes within the area measured fifty feet landward from the top-of-bank of any watercourse within a special flood hazard area
3. Special requirements for recreational vehicles within the special flood hazard area
4. Special requirement for accessory structure
5. Prohibiting new construction and development within the area measured fifty feet landward from the top-of-bank of any watercourse within a special flood hazard area
6. Providing the county conservation district an opportunity to review and comment on all applications and plans for any proposed construction or development in any identified floodplain area

The NFIP’s Community Rating System (CRS) provides discounts on flood insurance premiums in those communities that establish floodplain management programs that go beyond NFIP minimum requirements. Under the CRS, communities receive credit for more restrictive regulations, acquisition, relocation, or flood-proofing of flood prone buildings, preservation of open space, and other measures that reduce flood damages or protect the natural resources and functions of floodplains.

The CRS was implemented in 1990 to recognize and encourage community floodplain management activities that exceed the minimum NFIP standards. Section 541 of the 1994 Act amends Section 1315 of the 1968 Act to codify the Community Rating System in the NFIP. The section also expands the CRS goals to specifically include incentives to reduce the risk of flood-related erosion and to encourage measures that protect natural and beneficial floodplain functions. These goals have been incorporated into the CRS and communities now receive credit toward premium reductions for activities that contribute to them.

Under the Community Rating System, flood insurance premium rates are adjusted to reflect the reduced flood risk resulting from community activities that meet a minimum of three of the following CRS goals.

1. Reduce flood losses
2. Protect public health and safety
3. Reduce damage to property
4. Prevent increases in flood damage from new construction
5. Reduce the risk of erosion damage
6. Protect natural and beneficial floodplain functions
7. Facilitate accurate insurance rating
8. Promote the awareness of flood insurance

There are ten Community Rating System classes. Class 1 requires the most credit points and gives the largest premium reduction; class 10 receives no premium reduction. CRS premium discounts on flood insurance range from 5% for Class 9 communities up to 45% for Class 1 communities. The CRS recognizes eighteen credible activities, organized under four categories: Public Information, Mapping and Regulations, Flood Damage Reduction, and Flood Preparedness.

FEMA Region III makes available to communities an ordinance review checklist which lists required provisions for floodplain management ordinances. This checklist helps communities develop an effective floodplain management ordinance that meets federal requirements for participation in the NFIP.

According to the State NFIP Coordinator, all of Calvert County ’s municipalities have floodplain regulations in place that meet requirements set forth by the NFIP. Currently, no municipalities have completed or started to complete the CRS program. Additional research will be conducted on the CRS program and mitigation actions will be developed in support of the CRS.

To spread awareness as well as capture participation levels, all municipalities were instructed to complete an NFIP survey provided by the Federal Emergency Management Agency. Both municipalities in Calvert County submitted an NFIP survey. These surveys can be found in Appendix C of this plan.

Additional National Flood Insurance Program and Floodplain Management Information:

Town of Chesapeake Beach:

The floodplain management ordinance for the Town of Chesapeake Beach is call Ordinance 0-18-84 and was adopted by the town on December 19th, 1991. This floodplain ordinance offers comprehensive discussion and regulation on floodplain management in the town. There is significant discussion on floodplain zones in section 4.1. Article V of the Ordinance covers development and restrictions in nontidal and tidal floodplain zones. There is discussion under part A of Article V that discusses specific provisions for new or substantially improved construction. Part B of Article V discusses general restrictions for development in the floodways around Chesapeake Beach. Finally, part C outline restrictions for development or storage in coastal high hazard areas. There is discussion on manufactured homes in the coastal hazard areas. Significantly, no substantially improved structures can be located in the flood zone or the flood way. The FIRMs for the Town of Chesapeake Beach were effective on November 19, 2014. This includes the index FIRM and the northeast FIRM. Local commitments and requirements of the NFIP will be handled by a municipal floodplain management coordinator or floodplain manager or the designee at the town. More information on floodplain management and how it relates to the Town of Chesapeake Beach can be found in the submitted National Flood Insurance Program Survey for the town or at the floodplain management website located at: https://www.chesapeakebeachmd.gov/sites/g/files/vyhlif4261/f/uploads/floodplainordinanceo-7-91rm.pdf

Town of North Beach:

The floodplain management for the Town of North Beach is called Ordinance 14-03 and was adopted on October 9th, 2014. This floodplain ordinance offers comprehensive discussion and regulation on flood plain management in the town. There is significant discussion on community participation requirements for the National Flood Insurance Program and the relation of county regulations to that program in section 1.3. Section 4.7 of the floodplain ordinance prohibits the placement of new manufactured homes in floodways or coastal high hazard areas. Section 4.11 of the floodplain management ordinance limits and prohibits what can and cannot be stored in flood zones and section 5.4 and 5.5 covers the provisions for substantial improvement and substantial damage. The initial FIRM effective date for the Town of North Beach was September 28, 1984, and the current FIRM data was effective on November 19, 2014. Local commitments and requirements of the NFIP will be handled by a municipal floodplain management coordinator or floodplain manager or the designee at the town. More information on floodplain management and how it related to the Town of North Beach can be found in the submitted National Flood Insurance Program Survey for the town or at the floodplain management website located at:
https://www.northbeachmd.org/sites/g/files/vyhlif4786/f/uploads/nb_flood_ordinance_2015.pdf

5.2.2. Administrative and Technical Capability

There are two incorporated municipalities within Calvert County, the towns of Chesapeake Beach and North Beach. Each of these municipalities conducts it daily operations and provides various community services according to local needs and limitations. Some of these municipalities have formed cooperative agreements and work jointly with their neighboring municipalities to provide services such as police protection, fire and emergency response, infrastructure maintenance, and water supply management. Other municipalities choose to operate independently and provide such services internally. Municipalities vary in staff size, resource availability, fiscal status, service provision, constituent population, overall size, and vulnerability to the profile hazards. Technical capability relates to an adequacy of knowledge and technical expertise of local government employees or the ability to contract resources for this expertise in order to effectively execute mitigation activities. Common examples of skill sets, and technical personnel needed for hazard mitigation include: planners with knowledge of land development and management practices, engineers or professionals trained in construction practices related to buildings and/or infrastructure (e.g. building inspectors), planners or engineers with an understanding of natural and/or human caused hazards, emergency managers, floodplain managers, land surveyors, scientists familiar with hazards in the community, staff with education of expertise to assess community vulnerability to hazards, personnel skilled in geographic information systems, resource development staff or grant writers, fiscal staff to handle complex grant application processes.

County Planning Commission

In Maryland, planning responsibilities traditionally have been delegated to each county and local municipality through the Municipalities Planning Code (MPC). A planning agency acts as an advisor to the governing body on matters of community growth and development. A governing body may appoint individuals to serve as legal or engineering advisors to the planning agency. In addition to the duties and responsibilities authorized by Article II of the MPC, a governing body may, by ordinance, delegate approval authority to a planning agency for subdivision and land development applications. A governing body has considerable flexibility, not only as to which powers and duties are assigned to a planning agency, but also what form an agency will possess. A governing body can create a planning commission, a planning department, or both. The Calvert County Office of Planning & Zoning assists all municipalities in the county as needed.

Municipal Engineer

A municipal engineer performs duties as directed in the areas of construction, reconstruction, maintenance and repair of streets, roads, pavements, sanitary sewers, bridges, culverts, and other engineering work. The municipal engineer prepares plans, specifications and estimates of the work undertaken by the township. Most municipalities in Calvert County have a municipal engineer under contract to perform these duties.

Personnel Skilled in GIS or FEMA HAZUS Software

A geographic information system (GIS) is an integrated, computer-based system designed to capture, store, edit, analyze, and display geographic information. Some examples of uses for GIS technology in local government are land records management, land use planning, infrastructure management, and natural resources planning. As GIS automates existing operations such as map production and maintenance, saving a great deal of time and money. The GIS also includes information about map features such as the capacity of a municipal water supply or the acres of public land. GIS data is managed, maintained, and developed by a Calvert County GIS

Department, which is available to assist all the county's municipalities. GIS data is an important tool to use in hazard mitigation planning and is instrumental in assessing the risk of municipalities to various hazards.

Emergency Management Coordinator

Emergency management is a comprehensive, integrated program of mitigation, preparedness, response, and recovery for emergencies/disasters of any kind. No public or private entity is immune to disasters and no single segment of society can meet the complex needs of a major emergency or disaster on its own. Hence, the National Preparedness Goal of 2011 also defines what it means for the whole community to be prepared for all types of disasters and emergencies and lists five mission areas which support preparedness: prevention, protection, mitigation, response, and recovery – doubling the emphasis on mitigation activities in an emergency management program.

Calvert County and its municipalities are required to have an emergency management coordinator.

The Calvert County Department of Emergency Services coordinates countywide emergency management efforts. Each municipality has a designated local emergency management coordinator who possesses a unique knowledge of the impact hazardous events have on their community.

A local emergency management coordinator is responsible for emergency management – preparedness, response, recovery, and mitigation within his/her respective authority having jurisdiction. The responsibilities of the emergency management coordinator are outlined in MD Code, Public Safety § 14-109. All Calvert County municipalities have adopted the county EOP. The notification and resource section of the plan was developed individually by each municipality.

Federal Agency Assistance

There are many federal agencies that can provide technical assistance for mitigation activities, and these include, but are not limited to:

- United States Army Corps of Engineers (USACE)
- Department of Housing and Urban Development (HUD)
- Department of Agriculture (DOA)
- Economic Development Administration
- Emergency Management Institute (EMI)
- Environmental Protection Agency (EPA)
- Federal Emergency Management Agency (FEMA)
- Small Business Administration (SBA)

State Agency Assistance

There are many state agencies that can provide technical assistance for mitigation activities, and these include but are not limited to:

- Maryland Department of Emergency Management (MDEM)
- Maryland Department of Housing and Community Development (MDHCD)
- Maryland Department of Natural Resources (MDNR)
- Maryland Department of the Environment (MDE)

Political Capability

One of the most difficult capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects designed to mitigate hazard events. The adoption of hazard mitigation measures may be seen as an impediment to growth and economic development. In many cases, mitigation may not generate interest among local officials when compared with competing priorities. Therefore, the local political climate must be considered when designing mitigation strategies, as it could be the most difficult hurdle to overcome in accomplishing the adoption or implementation of specific actions.

The capability assessment survey was used to capture information on each jurisdiction's political capability. Survey respondents were asked to identify examples of political capability, such as guiding development away from hazard areas, restricting public investments or capital improvements within hazard areas, or enforcing local development standards that go beyond minimum state or federal requirements (i.e., building codes, floodplain management ordinances, etc.). These examples were used to guide respondents in scoring their community on a scale of "unwilling" (0) to "very willing" (5) to adopt policies and programs that reduce hazard vulnerabilities. *Table 77 – Calvert County Community Political Capability* summarizes the results of political capability.

Table 77 - Calvert County Community Political Capability

Calvert County Community Political Capability						
Municipality Name	Capability Ranking					
	0	1	2	3	4	5
Chesapeake Beach						X
North Beach					X	

In addition to the institutional capability of the municipal government structure described above, the county itself can engage in mitigation activities. The county has its own staff, resources, budget, and objectives, which may or may not be like those of its constituent municipalities. Therefore, the county has its own capabilities to mitigate the profiled hazards through planning and coordination of local mitigation efforts. The Calvert County GIS Department can provide needed skills in the analysis of geographic data. Other local organizations that can and do act as partners include the Calvert County Office of Planning & Zoning, the Calvert County Conservation District, the Calvert County Redevelopment Authority, the Calvert County Area Agency on Aging, the Fire Advisory Committee and Regional Firefighters Association, business development organizations, and historical or cultural agencies.

Existing Limitations

Funding has been identified as the largest limitation for a municipality to complete mitigation activities. The acquisition of grants is the best way to augment this process the municipalities. The county and municipality representatives will need to rely on regional, state, and federal partnerships for future financial assistance. Development of intra-county regional partnerships and intra-municipality regional partnerships will bolster this process.

5.2.3. Financial Capability

Fiscal capability is significant to the implementation of hazard mitigation activities. Every jurisdiction must operate within the constraints of limited financial resources. The decision and capacity to implement mitigation-related activities is often strongly dependent on the presence of financial resources. While some mitigation actions are less costly than others, it is important that money is available locally to implement policies and projects. Financial resources are particularly important if communities are trying to take advantage of state or federal mitigation grant funding opportunities that require local-match contributions. Based on survey results, most municipalities within the county perceive fiscal capability to be moderate. The following information pertains to various financial assistance programs relevant to hazard mitigation.

State and Federal Grants

During the 1960s and 1970s state and federal grants-in-aid were available to finance many municipal programs, including streets, water and sewer facilities, airports, parks, and playgrounds. During the early 1980s, there was a significant change in federal policy, based on rising deficits and a political philosophy that encouraged states and local governments to raise their own revenues for capital programs. The result has been a growing interest in “creative financing”.

Grant programs that may be utilized to accomplish hazard mitigation objectives include the: Act 167 Stormwater Management; Source Water Protection; and Flood Protection Programs. The Flood Protection Programs include the Flood Mitigation Assistance Grant Programs (FMA), and Hazard Mitigation Grant Program.

Below are some of the federal programs that may provide financial support for mitigation activities:

- FEMA Building Resilient Infrastructure and Communities (BRIC)
- FEMA Community Assistance Program – State Support Services Element (CAP-SSSE)
- FEMA Community Disaster Loan Program
- FEMA Community Rating System
- FEMA Emergency Management Performance Grants (EMPG)
- FEMA Environmental Planning and Historic Preservation Program (EHP)
- FEMA Flood Mitigation Assistance Program
- FEMA Hazard Mitigation Grant Program (HMGP)
- FEMA Hazard Mitigation Grant Program (HMGP) Post-Fire
- FEMA High-Hazard Potential Dam (HHPD) Program
- FEMA Individuals and Households Program (IHAP)
- FEMA National Dam Safety Program
- FEMA National Flood Insurance Program
- FEMA Pre-Disaster Mitigation Program
- FEMA Public Assistance Program (PA)
- FEMA Regional Catastrophic Preparedness Grant Program
- FEMA Repetitive Flood Claims Program (RFC)
- FEMA Severe Repetitive Loss Grant Program
- USACE Continuing Authorities Program
- USACE Flood Plain Management Services Program (FPMS)
- USACE Inspection of Completed Works Program (ICW)
- USACE National Levee Safety Program
- USACE Planning Assistance to States
- USACE Rehabilitation and Inspection Program (RIP)

Capital Improvement Financing

Because most of the capital investments involve the outlay of substantial funds, local governments can seldom pay for these facilities through annual appropriations in the annual operating budget. Therefore, numerous techniques have evolved to enable local government to pay for capital improvements over a time period exceeding one year. Public finance literature and state laws governing local government finance classify techniques that are used to finance capital improvements. The techniques include revenue bonds, lease-purchase, authorities and special district, current revenue (pay-as-you-go); reserve funds; and tax increment financing. Most municipalities have very limited local tax funds for capital projects. Grants and other funding are always priorities.

Indebtedness through General Obligation Bonds

Some projects may be financed with general obligation bonds. With this method, the jurisdiction's taxing power is pledged to pay interest and principal to retire debt. General obligation bonds can be sold to finance permanent types of improvements, such as schools, municipal buildings, parks, and recreational facilities. Voter approval for this may be required.

Municipal Authorities

Municipal authorities are most often used when major capital investments are required. In addition to sewage treatment, municipal authorities have been formed for water supply, airports, bus transit systems, swimming pools, and other purposes. Joint authorities have the power to receive grants, borrow money, and operate revenue generating programs. Municipal authorities are authorized to sell bonds, acquire property, sign contracts, and take similar actions. Authorities are governed by authority board members, who are appointed by the elected officials of the member municipalities.

Sewer Authorities

Sewer authorities include multi-purpose authorities with sewer projects. They sell bonds to finance acquisition of existing systems for construction, extension, or system improvement. Sewer authority operating revenues originate from user fees. The fee frequently is based on the amount of water consumed and payment is enforced by the ability to terminate service by the imposition of liens against real estate. In areas with no public water supply, flat rate charges are calculated on average use per dwelling unit.

Water Authorities

Water authorities are multi-purpose authorities with water projects, many of which operate both water and sewer systems. The financing of water systems for lease back to the municipality is one of the principal activities of the local government facilities' financing authorities. An operating water authority issues bonds to purchase existing facilities to construct, extend, or improve a system. The primary source of revenue is user fees based on metered usage. The cost of construction or extending water supply lines can be funded by special assessments against abutting property owners. Tapping fees also help fund water system capital costs. Water utilities are also directly operated by municipal governments and by privately owned public utilities regulated by the Maryland Public Service Commission. The Maryland Department of the Environment has a program to assist with consolidating small water systems to make system upgrades more cost effective.

U.S. Department of Agriculture Circuit Riding Program (Engineer)

The Circuit Riding Program is an example of intergovernmental cooperation. This program offers municipalities the ability to join to accomplish a common goal. The circuit rider is a municipal engineer who serves several small municipalities simultaneously. These are municipalities that may be too small to hire a professional engineer for their own operations yet need the skills and expertise the engineer offers. Municipalities can jointly obtain what no one municipality could obtain on its own.

5.2.4. Education and Outreach

The Calvert County Division of Emergency Management conducts public outreach at public events to update the citizens and visitors of the county on natural and human-caused hazards. The county conservation district also conducts outreach on various activities and projects in the county.

Education activities that directly impact hazard mitigation in Calvert County predominantly revolve around the first responders. Providing fire, medical, search and rescue training, and education enhances the response and recovery capabilities of response agencies in the county. Newly appointed emergency management coordinators are trained in both Duties and Responsibilities and damage assessment – which includes a discussion on mitigation; this training can be translated into teaching municipal employees or local emergency services to assist them during a disaster.

The county also has several websites and social media accounts that can educate residents about hazard mitigation and risk while also communicating information in the event of a disaster:

https://www.calvertcountymd.gov/94/Community-Resources

The Calvert County GIS Department website has an education and outreach capability, particularly with the county map viewer, which could be updated to include hazard mitigation data. The websites of the Calvert County Division of Emergency Management and the Calvert County Planning Department also post information to educate residents, particularly in disaster preparedness, floodplain management, and zoning requirements. The Calvert County Planning Department currently provides access to planning documents and educational brochures about the benefits of planning and helpful guides. The DES also holds quarterly Local Emergency Planning Committee (LEPC) meetings that are open to the public, which serve as another means to conduct outreach and educate the public about hazard mitigation.

Education and outreach on the NFIP are necessary. With new regulations in flood-plain management, updated digital flood insurance rate maps and new rates for insurance policies, education, and outreach on the NFIP would assist the program. The Calvert County Local Planning Team will identify actions necessary to complete this.

5.2.5. Plan Integration

Plan integration recognizes that hazard mitigation is most effective when it works in efficient coordination with other plans, regulations, and programs. Plan integration promotes safe, resilient growth, effective management, an overall reduction of risk, by ensuring that the goals and actions established in the Hazard Mitigation Plan are included in the comprehensive planning efforts so they can affect future land use and development. Some of the most important areas of planning and regulatory capabilities which hazard mitigation goals and actions should be integrated include comprehensive plans, the hazard mitigation plans from all surrounding or encompassing areas, EOPs, building codes, floodplain ordinances, subdivision, land development ordinances, stormwater management plans and ordinances, and zoning ordinances. All of these tools provide mechanisms for the implementation of adopted mitigation strategies.

Calvert County Comprehensive Plan

Overview

Comprehensive plans establish the overall vision, goals, and objectives for a community's growth. The Calvert County Comprehensive Plan was adopted by the Calvert County Commissioners in August of 2019. The plan is a collaborative effort between the counties in the region and contains both regional priorities and action plans for each county in the region. The plan establishes countywide goals and objectives, describes environmental and demographic characteristics, identifies potential capital improvement projects, and inventories existing planning initiatives and tools in the county.

As part of the update process, the goals and objectives in the 2018 Comprehensive Plan were reviewed, and those that are currently supportive of hazard mitigation goals and principles were identified. The plan also identified opportunities to integrate goals and objectives from the 2017 Hazard Mitigation Plan and 2023 HMP Update into the next update of the comprehensive plan.

Recommendations for Continued and Future Integration

As discussed, many of the goals and objectives outlined in the Calvert County Comprehensive Plan are related to the hazard mitigation risks and goals established in the HMP. Several could be revised to include updated information from this HMP. Additionally, the comprehensive plan can identify the places of higher vulnerability that are identified in this plan for all the high-risk hazards, and include objectives aimed at reducing the risk to these vulnerable areas. For example, an objective of the comprehensive plan could be to encourage elevation and flood proofing of structures in the Special Flood Hazard Area (SFHA) by seeking Flood Mitigation Assistance (FMA) grants and strictly enforcing floodplain management ordinances in certain communities (See Section 4.3.5 for Flooding and Flash Flooding information). Similarly, an objective for communities that are most vulnerable to subsidence and land failure could be to educate property owners about mine subsidence, associated risks, and actions to take in the event of an emergency. These types of objectives could also be created for medium-risk hazards when appropriate.

Another key opportunity for further integration of hazard mitigation into planning and regulatory tools is to incorporate hazard mitigation goals and objectives into the ongoing Calvert County Comprehensive Plan update. The Calvert County Comprehensive Plan also ties into the Calvert

County Hazard Mitigation Plan when mitigation strategy is considered. The mitigation principles outlined in this hazard mitigation plan are used and reviewed in long-range planning throughout Calvert County.

Calvert County Flood Mitigation Plan

Flood mitigation plans are additional plans that local jurisdictions can put into place to directly address flood related items and the risk of floods to the local populace. Calvert County developed a flood mitigation plan and adopted the plan on August 2, 2011. The previous hazard mitigation plan for Calvert County included an action in the mitigation strategy section to incorporate this flood mitigation plan as an annex of that hazard mitigation plan.

Recommendations for Continued and Future Integration

Similar to the comprehensive plan, the flood mitigation plan offers goals and objectives for flood related items that can be directly related to this hazard mitigation plan. The goals and objectives from the flood mitigation plan should be updated and the updates integrated into the hazard mitigation plan. The increase in emergency services shortages introduces another chance for continued integration. The flood mitigation plan includes specific goals and objectives related emergency services, and these should be worked directly into the emergency services mitigation goals, objectives, and actions in this hazard mitigation plan. The Calvert County Division of Emergency Management and Calvert County Environmental Planning are continuing to collaborate on successful continued integration of the flood mitigation plan and the hazard mitigation plan. The two entities are also collaborating to ensure that those plans align with one another and provide for more resilient outcomes in the future.

Integration of hazard mitigation into local mechanisms

Integration of hazard mitigation principles into local mechanisms can be efficient for Calvert County. With only two incorporated municipalities, local mitigation mechanisms can directly interface with the Calvert County HMP. These potential integration items include municipal comprehensive plans, municipal flood plans, or development plans for transportation and community resources. Those incorporated municipalities should review the completed HMP and utilize items identified in the risk assessment, mitigation strategy, and capability assessment sections. Previously, hazard mitigation information from the Calvert County plans has been integrated into other planning mechanisms. Each of the Town Centers can also utilize portions of the hazard mitigation plan into their planning mechanisms, but this can be completed under the authority of Calvert County. These planning mechanisms could include comprehensive plans, flood plans, or development plans for transportation.

Previous successful mitigation and plan integration has occurred in the development of comprehensive plans at the local level, both for the incorporated municipalities and the Town Centers. The risk assessment sections of the Town Center Master Plans in Calvert County pull information directly from the risk assessment section of the previous Calvert County Hazard Mitigation Plans, and this informative process will continue with the future development of those items.

Further discussion on plan integration can be found in section 7.3 of this hazard mitigation plan.

6. Mitigation Strategy

6.1. Update Process Summary

Mitigation goals are general guidelines that explain what the county wants to achieve. Goals are usually expressed as broad policy statements representing desired long-term results. Mitigation objectives describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date. There were ten goals and twenty-two objectives identified in the 2017 hazard mitigation plan. The 2023 Calvert County Hazard Mitigation Plan Update has eight goals and twenty-four objectives. Objectives have been added and arranged in order to associate them with the most appropriate goal. Goals have also been combined and merged to reflect the changes in mitigation strategy and the priorities of the county since 2017. These changes are noted in *Table 78 – 2017 Mitigation Goals and Objectives Review*. These reviews are based on the five-year hazard mitigation plan review worksheet, which includes a survey on existing goals and objectives completed by the local planning team. Municipal officials then provided feedback on the changes to the goals and objectives via a mitigation strategy update meeting. Copies of these meetings and all documentation associated with the meetings are located in Appendix C.

Actions provide more detailed descriptions of specific work tasks to help the county and its municipalities achieve prescribed goals and objectives. There were thirty-nine actions identified in the 2017 mitigation strategy. A review of the 2017 mitigation actions was completed by the local planning team. The results of this review are identified in *Table 79 – 2017 Mitigation Actions Review*. Actions were evaluated by the local planning team with the intent of carrying over any actions that were not started or continuous for the next five years. Actions were also reviewed by the local jurisdictions, including the incorporated municipalities, to reflect any mitigation actions changes and changes in priorities for those jurisdictions.

Table 78 - 2017 Mitigation Goals and Objectives Review

Calvert County Mitigation Goals and Objectives		
GOAL Objective	**Description**	**Comment**
Goal 1	**Minimize losses and institute adequate regulations through land use regulations.**	**2023 Review Comment: “**Minimize losses and institute adequate policies through land use regulations, for hazard mitigation.”
Objective 1.1	Identify and support public and private projects and programs to retrofit, relocate, or acquire properties as well as remove structures susceptible to repetitive flooding.	**2023 Review Comment:** “Identify and support public and private projects and programs to retrofit, relocate, or acquire properties as well as remove structures susceptible to repetitive flooding, and other natural hazards.”

Calvert County Mitigation Goals and Objectives		
GOAL Objective	**Description**	**Comment**
Objective 1.2	Continue to implement systematic maintenance programs for stormwater management systems.	**2023 Review Comment:** Discuss with DPW.
Objective 1.3	Discourage new development in high hazard areas through appropriate regulations and land use planning.	**2023 Review Comment:** No comment.
Objective 1.4	Enforce local, state, and federal floodplain regulations and building standards for development in flood hazard areas.	**2023 Review Comment:** "Enforce local, state, and federal floodplain regulations and building standards for development in flood hazard areas, steep slopes, erodible soils, or inadequate wastewater facility locations." Include language to call out septic system collapse on cliffsides.
Goal 2	**Ensure hazard mitigation goals are consistent with all other County and Municipal plans and ordinances.**	**2023 Review Comment:** Uncapitalize "municipal."
Objective 2.1	Incorporate hazard mitigation principles into new and existing plans and ordinances.	**2023 Review Comment:** "Integrate hazard mitigation principles into new and existing plans and ordinances."
Objective 2.2	Integrate a hazard mitigation section into Calvert County Comprehensive Plan and Chesapeake Beach and North Beach Comprehensive Plans.	**2023 Review Comment:** Move into new action. "Integrate a hazard mitigation section into the Chesapeake Beach and North Beach Comprehensive Plans." Coordinate with North Beach and Chesapeake Beach to integrate hazard mitigation into comprehensive plans.
Goal 3	**Minimize future losses from all disasters by reducing the risk to people and property.**	**2023 Review Comment:** Change to new Goal 1.
Objective 3.1	Protect populations and properties throughout Calvert County that may be susceptible to economic or physical loss from disasters, consistent with the standards established in this Plan and other plans which have, or may be, adopted by the County or Towns.	**2023 Review Comment:** Revisit after combining Goal 10 with Goal 3. Add as new objective under Goal 1

Calvert County Mitigation Goals and Objectives		
GOAL Objective	**Description**	**Comment**
Objective 3.2	Provide protection of critical facilities/infrastructure vital to disaster response, such as fire and police stations, and those vital to the continuous operations of the County, municipalities and communities, such as hospitals and health care facilities, water and sewer facilities, electrical and other utilities, and transportation systems.	**2023 Review Comment:** Split into two new objectives under Goal 1.
Goal 4	**Emphasize pre- and post-disaster planning to decrease vulnerability to loss of existing and new construction.**	**2023 Review Comment: "**Emphasize pre- and post-disaster planning to decrease vulnerability of existing and new construction."
Objective 4.1	Promote to elected officials, builders, and existing and potential homeowners, the economic and safety benefits of designing mitigation features into new construction and retrofit of existing structures.	**2023 Review Comment:** "Promote the benefits of economic and safety features in new construction and the retrofit of existing structures to all stakeholders."
Objective 4.2	Identify vulnerable existing critical facilities and infrastructure and encourage pre-disaster retrofit.	**2023 Review Comment:** No comment.
Goal 5	**Support a balance between government regulation/enforcement, and personal awareness/responsibility for hazard mitigation, by emphasizing education and training for property owners, families and individuals.**	**2023 Review Comment: "**Support a balance between government and personal awareness/responsibility for hazard mitigation, by emphasizing education and training for all stakeholders." OR "Emphasize education and training for the whole community."
Objective 5.1	Continue to develop and support disaster preparedness education and awareness programs, targeting residents, visitors, businesses, and elected officials.	**2023 Review Comment:** No comment.
Objective 5.2	Continue to develop economic incentive programs, for both public and private sectors, that promote structural retrofitting where and when it is determined to be the best option.	**2023 Review Comment:** No comment.

Calvert County Mitigation Goals and Objectives		
GOAL Objective	**Description**	**Comment**
Goal 6	**Emphasize the benefits of hazard mitigation principles through ongoing public outreach activities.**	**2023 Review Comment:** Merge into goal 5.
Objective 6.1	Educate the public on higher standards of protection to structures and facilities.	**2023 Review Comment:** No comment.
Objective 6.2	Identify and coordinate public information programs and events such as contests and festivals with public and private partners.	**2023 Review Comment:** Turn into action.
Objective 6.3	Identify and seek funding sources that will support hazard mitigation awareness and training programs.	**2023 Review Comment:** No comment.
Goal 7	**Reduce economic vulnerability and increase recovery capabilities of business and industry.**	**2023 Review Comment:** Turn into new objective under Goal 5.
Objective 7.1	Continue public education and outreach on the topics of economic vulnerability and recovery through collaborative programs involving government, businesses, and community organizations.	**2023 Review Comment:** Internal review. Determine if necessary or redundant. Kara: turn into action.
Goal 8	**Protect natural resources and open-spaces that provide flood and other hazard mitigation.**	**2023 Review Comment:** No comment.
Objective 8.1	Encourage actions that protect natural resources while supporting community resiliency and hazard mitigation efforts.	**2023 Review Comment:** Use more strong language to protect natural resources, rather than just "encourage."
Objective 8.2	Coordinate natural resource preservation and land use planning to ensure that those natural resource areas, that are shown in this or other adopted community plans to provide hazard mitigation benefits, remain open spaces, and retain the natural benefits they provide.	**2023 Review Comment:** No comment.

Calvert County Mitigation Goals and Objectives		
GOAL Objective	**Description**	**Comment**
Goal 9	**Ensure continued coordination and linkages between local jurisdictions and neighboring county and statewide mitigation and resiliency activities to strengthen response and recovery efforts.**	**2023 Review Comment: "**Ensure continued coordination between local jurisdictions, neighboring counties, to strengthen response and recovery efforts."
Objective 9.1	Include local, regional, and statewide jurisdictions in trainings, drills, and exercises to strengthen interagency cooperation.	**2023 Review Comment:** No comment.
Objective 9.2	Encourage open data and/or data sharing policies and agreements between municipal, county, regional and state jurisdictions to aide in hazard and emergency response, and prepare for Next Generation 911 implementation.	**2023 Review Comment:** County to review. Possibly remove NG911.
Goal 10	**Protect infrastructure, and critical facilities to reduce potential disruption of regular activities during and after hazard events.**	**2023 Review Comment:** Move as New Objective 1.1 under Goal 3 (New Goal 1). Create a new goal, with similar language, for community lifelines, as New Objective 1.2.
Objective 10.1	Efficiently utilize resources to reinforce infrastructure, to withstand potential hazards, and to ensure continued use during and after an event.	**2023 Review Comment:** Combine with Objective 3.2
Objective 10.2	Coordinate with the Towns of Chesapeake Beach and North Beach to research, secure, and effectively use external, or additional, sources of funding to help make the infrastructure and critical facilities on which the residents, businesses and visitors of the County and Towns depend, more resilient to various hazards and events.	**2023 Review Comment:** No comment.

Table 79 - 2017 Mitigation Actions Review

Calvert County Mitigation Actions Review Worksheet						
Existing Mitigation Actions *(2017 HMP)*	***Status***					***Review Comments***
	No Progress/ Unknown	**In Progress/Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
1. Continue to support a regular maintenance program for emergency generators at the county's critical facilities. Develop a regular maintenance program that includes a schedule to change filters, etc.			X			**2023 Review Comment:** "critical facilities and community lifelines." Objective 1.1
2. Update Comprehensive Plan to include a Hazard Mitigation Section that provides an assessment of hazard vulnerability and appropriate mitigation recommendations.			X			**2023 Review Comment:** "Continuing to update. We are also incorporating hazard analyses into the Town Center master plans." Objective 3.1
3. Continue to conduct routine inspections, regular maintenance, and annual tests on all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event.			X			**2023 Review Comment:** Objective 1.1
4. Continue to ensure that a planned, coordinated, and effective public warning dissemination program exists at the local level and is well maintained.			X			**2023 Review Comment:** Objective 1.1
5. Utilize existing technical proficiency at the local level for conducting post-disaster damage assessments.			X			**2023 Review Comment:** No comment
6. Ensure reconstruction activities are compliant with NFIP substantial damage/improvement requirements and existing codes.			X			**2023 Review Comment:** Objective 2.1

Calvert County Mitigation Actions Review Worksheet						
	Status					
Existing Mitigation Actions *(2017 HMP)*	**No Progress/ Unknown**	**In Progress/Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	***Review Comments***
7. Introduce NOAA Weather Alert radios in designated critical facilities across the county for situational awareness.		X				**2023 Review Comment:** "We are utilizing a variety of tools to send alerts and notifications, including Everbridge and the Calvert Prepare mobile app" "critical facilities and community lifelines"
8. Continue to develop and distribute a public informational pamphlet related to the potential health and safety implications of various natural hazard events. Also place the information on the County website and COMCAST.			X			**2023 Review Comment:** Objective 5.1
9. Continue to conduct hazard response practice drills and emergency management training exercises on an annual basis.			X			**2023 Review Comment:** Objective 7.1
10. Identify natural resources that provide natural mitigation such as wetlands, buffers, etc and make them a priority for conservation.			X			**2023 Review Comment:** Objective 6.2
11. Develop and implement a post-disaster recovery plan.		X				**2023 Review Comment:** Objective 3.1
12. Continue to work with local radio stations to promote continuity of public awareness and disaster preparedness.			X			**2023 Review Comment:** Objective 5.1
13. Continue to maintain and replace county owned critical infrastructure.			X			**2023 Review Comment:** "critical infrastructure and functional needs"

Calvert County Mitigation Actions Review Worksheet						
Existing Mitigation Actions *(2017 HMP)*	***Status***					***Review Comments***
	No Progress/ Unknown	**In Progress/Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
14. In flooded areas, conduct to conduct rigorous sampling and analysis of public and private drinking water supply sources immediately after an inundating flood event and issue boil water advisories as needed.					X	**2023 Review Comment:** "EM and Environmental Health agreed this action is inappropriate for the HMP and can be removed." Goal 2
15. Work with local businesses and local industry owners to develop a continuity of operations plan.		X				**2023 Review Comment:** "Currently working with Economic Development to plan a Lunch n' Learn in September 2023 for National Preparation Month." Objective 5.5
16. Continue to provide technical assistance to local residents and business owners in applying for hazard mitigation/assistance funds and identifying cost beneficial mitigation measures to incorporate into reconstruction activities.			X			**2023 Review Comment:** "5 demolitions, 3 elevations currently funded. More projects identified for the future." Objective 5.4
17. Continue to ensure County and municipal compliance with local Stormwater Management Plans.			X			**2023 Review Comment:** Objective 3.1
18. Continue to ensure compliance with approved Erosion and Sedimentation Control Plans and continue to work with local farmers to implement BMPs.			X			**2023 Review Comment:** Objective 3.1
19. Continue to distribute a public summary of this hazard mitigation plan including relevant information on hazard-prone areas, hazard specific "do's" and "don'ts" and emergency contact information.			X			**2023 Review Comment:** Objective 5.1
20. Maintain zoning ordinance provisions for protection of all hazard areas.			X			**2023 Review Comment:** Objective 6.1

Calvert County Mitigation Actions Review Worksheet						
Existing Mitigation Actions *(2017 HMP)*	***Status***					***Review Comments***
	No Progress/ Unknown	**In Progress/Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
21. Continue to coordinate with the County, municipality and/or the Maryland Department of Transportation on the potential feasibility of replacing, removing, or enlarging those bridge and culvert stream crossings that are unable to pass the 10-year frequency flood flow.			X			**2023 Review Comment:** "Working with Department of Public Works to identify projects for replacing, retrofitting, correcting, stormwater infrastructure throughout the county." Objective 2.1
22. Give high priority to undeveloped floodplain areas for preservation.			X			**2023 Review Comment:** "Give high priority to undeveloped floodplain areas, forested wetlands, and emergent wetlands for natural preservation." Objective 6.2
23. Continue a community-specific stormwater maintenance program consisting of routine inspections and subsequent debris removal.			X			**2023 Review Comment:** "Maintained by Department of Public Works" Objective 5.2?
24. Recommend to the Board of Education to develop and implement a natural hazards awareness curriculum.			X			**2023 Review Comment:** Objective 5.6
25. Reduce vulnerability to wildfires by providing public education on increasing buffers and defensible spaces.	X					**2023 Review Comment:** Objective 2.3
26. Make recommendations to the state to develop a disclaimer for developing along the cliffs.		X				**2023 Review Comment:** "Continuing to identify and implement awareness and mitigation solutions for the cliffs." Objective 2.3

Calvert County Mitigation Actions Review Worksheet						
Existing Mitigation Actions (2017 HMP)	*Status*					*Review Comments*
	No Progress/ Unknown	In Progress/Not Yet Complete	Continuous	Completed	Discontinued	
27. Continue to encourage Calvert County citizens to be better prepared to face hazards by promoting and offering Community Emergency Response Team (CERT) training/classes to increase the number of citizen responders in the municipalities and population centers.		X				**2023 Review Comment:** “EM is making efforts to reactivate the CERT program for Calvert. Constrained by staff capacity limits.” Objective 5.1
28. Continue to identify at-risk populations (elderly, homeless, persons with physical or mental disabilities) to various hazards and maintain records of those vulnerable populations and the types of assistance they may need before, during, or after a hazard.			X			**2023 Review Comment:** Objective 1.2
29. Continue to conduct annual Training Exercises for all hazard events at least twice a year.					X	**2023 Review Comment:** “Need to rewrite – this isn’t being continued. EM does not have the capacity to offer these exercises. We do conduct plan reviews and facilitate training to encourage awareness. Need a dedicated T&E specialist to achieve this.” Objective 7.1
30. Continue the process to meet requirements to become certified as a Storm Ready Community (by the National Weather Service StormReady® Program).				X		**2023 Review Comment:** Objective 2.4
31. Conduct seminars in schools on various hazards that could threaten the County and provide informational packets for students to take home.		X				**2023 Review Comment:** “We currently provide these trainings to community groups on-demand. Still developing outreach strategy to include CCPS” Objective 5.1

Calvert County Mitigation Actions Review Worksheet						
Existing Mitigation Actions *(2017 HMP)*	***Status***					***Review Comments***
	No Progress/ Unknown	**In Progress/Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
32. Implement FEMA's Integrated Public Alert and Warning System (IPAWS) for sudden onset hazards such as tornados, thunderstorms, or flash floods.				X		**2023 Review Comment:** No comment
33. Create a ReadyCalvert website for hazard education and preparedness to inform residents on what to do before, during, and after each potential hazard.					X	**2023 Review Comment:** "EM shares hazard information on the county website in a variety of ways. More detailed and interactive info can be found on the Calvert Prepare mobile app." Objective 5.1
34. Continue to maintain relationships with the County School Board to enhance the County's shelter capabilities.			X			**2023 Review Comment:** Objective 5.6
35. Develop a volunteer database to identify qualified shelter staff (nurses, teachers, retired military, police, or emergency services, etc.) to bolster the County's staffing capabilities.		X				**2023 Review Comment:** "EM has a list of individuals interested in CERT training. Activating volunteers for county response has liability implications not yet addressed." Objective 1.5
36. Conduct data analytics of the County's emergency websites and media outlets to track the reach and efficacy of information including news posts, bulletins, and reading materials.		X				**2023 Review Comment:** "CMR tracks metrics for outreach and social media posts. No formal reporting process implemented at this time." No comment
37. Develop an Emergency Management "Brand" to be the face of Emergency Preparedness and provide a trusted and reliable source of information to the public. Raise awareness of the County's Emergency Management Division and their roles and responsibilities.		X				**2023 Review Comment:** No comment

Calvert County Mitigation Actions Review Worksheet						
Existing Mitigation Actions (2017 HMP)	*Status*					*Review Comments*
	No Progress/ Unknown	In Progress/Not Yet Complete	Continuous	Completed	Discontinued	
38. Work with the Board of Education to introduce and conduct tornado drills in schools and educate children and families about the growing threat of tornados.		X				**2023 Review Comment:** No comment
39. Continue to coordinate with County PIO to develop a "pre-approved' set of releases to be disseminated to the public in a timely manner in the event of an emergency.			X			**2023 Review Comment:** No comment

6.2. Mitigation Goals and Objectives

Based on results of the goals and objectives evaluation exercise and input from the local planning team, a list of eight goals and twenty-four corresponding objectives were developed. *Table 80 – 2023 Goals and Objectives* details the mitigation goals and objectives established for the 2023 Calvert County Hazard Mitigation Plan.

Table 80 - 2023 Goals and Objectives

Calvert County 2023 Mitigation Goals and Objectives	
Goal Objective	**Description**
Goal 1	**Minimize future losses from all disasters by reducing the risk to people and property.**
Objective 1.1	Protect infrastructure including critical facilities to reduce potential disruption of regular activities during and after hazard events and protect/reinforce emergency service facilities including but not limited to fire stations, EMS stations, police stations, and emergency warning systems.
Objective 1.2	Protect infrastructure including community lifelines to reduce potential disruption of regular activities during and after hazard events.

Calvert County 2023 Mitigation Goals and Objectives	
Goal Objective	**Description**
Objective 1.3	Protect populations and properties throughout Calvert County that may be susceptible to economic or physical loss from disasters and hazard events, consistent with the standards established in this plan and other plans which have, or may be, adopted by the county or towns.
Objective 1.4	Increase the preparedness of emergency shelters around Calvert County including pre-, during, and post-disaster.
Objective 1.5	Coordinate with the Towns of Chesapeake Beach and North Beach to research secure, and effectively use external, or additional, sources of funding to help make the critical facilities and community lifelines more resilient to various hazard events.
Goal 2	**Minimize losses and institute adequate policies through land use regulations for hazard mitigation.**
Objective 2.1	Identify and support public private projects and programs to retrofit, relocate, or acquire properties as well as remove structures susceptible to repetitive flooding, and other natural hazards.
Objective 2.2	Continue to implement systematic maintenance programs and projects for stormwater management systems.
Objective 2.3	Discourage new development in high hazard areas through appropriate regulations and land use planning.
Objective 2.4	Enforce local, state, and federal floodplain regulations and building standards for development in flood hazard areas, steep slopes, erodible soils, or inadequate wastewater facilities including septic systems collapse/failure.
Goal 3	**Ensure hazard mitigation goals are consistent with all other county and municipal plans and ordinances.**
Objective 3.1	Integrate hazard mitigation principles into new and existing plans and ordinances.
Goal 4	**Emphasize pre- and post-disaster planning to decrease vulnerability of existing and new construction.**
Objective 4.1	Promote the benefits of economic and safety features in new construction and the retrofit of existing structures to all stakeholders.
Goal 5	**Support a balance between government and personal awareness/responsibility for hazard mitigation, by emphasizing education and training for all stakeholders and the benefits of hazard mitigation principles.**
Objective 5.1	Continue to develop and support disaster preparedness education and awareness programs, targeting residents, visitors, businesses, and elected officials.

Calvert County 2023 Mitigation Goals and Objectives	
Goal Objective	**Description**
Objective 5.2	Continue to develop economic incentive programs, for both public and private sectors, that promote structural retrofitting where and when it is determined to be the best option.
Objective 5.3	Educate the public on higher standards of protection to all structures and facilities.
Objective 5.4	Identify and seek funding sources that will support hazard mitigation awareness and training programs.
Objective 5.5	Reduce economic vulnerability and increase recovery capabilities of business and industry.
Objective 5.6	Foster coordination between public entities in Calvert County for disaster preparedness, response, and recovery.
Goal 6	**Protect natural resources and open spaces that provide flood and other hazard mitigation.**
Objective 6.1	Promote actions that protect natural resources while supporting community resiliency and hazard mitigation efforts.
Objective 6.2	Coordinate natural resource preservation and land use planning to ensure that those natural resource areas retain the natural benefits they provide. This includes areas covered in this plan or other plans adopted by the county and community plans.
Goal 7	**Ensure continued coordination between local jurisdictions and neighboring counties to strengthen response and recovery efforts.**
Objective 7.1	Include local, regional, and statewide jurisdictions in trainings, drills, and exercises to strengthen interagency cooperation.
Objective 7.2	Encourage open data and/or data sharing policies and agreements between municipal, county, regional, and state jurisdictions to aide in hazard and emergency response.
Goal 8	**Participate in FEMA's High-Hazard Potential Dam Program (HHPD)**
Objective 8.1	Educate Calvert County incorporated municipalities, property owners, and business about FEMA's HHPD program.
Objective 8.2	Reduce long-term vulnerabilities from eligible high-hazard potential dams that pose an unacceptable risk to the public.
Objective 8.3	Identify, by area, locations in Calvert County that could potentially be impacted by FEMA's HHPD program.

Goal 8 and Objective 8.1, Objective 8.2, and Objective 8.3 relate to multiple mitigation actions in *Table 82 – 2023 Mitigation Action Plan*. Action 8.1.1 relates to Objective 8.1, Action 8.2.1 relates to Objective 8.2, and Action 8.3.1 relates to Objective 8.3. All three of the mitigation actions are covered by Goal 8 of the goals and objectives for the 2023 Hazard Mitigation Plan. These mitigations reduce the vulnerability of county populations and structures by educating the public on the HHPD program, enhancing local policies and procedures for HHPD planning, and digitizing dam inundation areas for future analysis and prevention of losses.

6.3. Identification and Analysis of Mitigation Techniques

This section includes an overview of alternative mitigation actions based on the goals and objectives identified in Section 6.2. There are four general mitigation strategy techniques to reduce hazard risks.

- Planning and regulations
- Structure and infrastructure
- Natural systems protection
- Education and awareness

Planning and Regulations: These actions include government authorities, policies or codes that influence the way land and buildings are developed and built. The following are some examples.

- Comprehensive plans
- Land use ordinances
- Subdivision regulations
- Development review
- Building codes and enforcement
- National Flood Insurance Program and Community Rating System
- Capital improvement programs
- Open space preservation
- Stormwater management regulations and master plans

The planning and regulations technique will protect and reduce the impact of specific hazards on new and existing buildings by improving building code standards and regulating new and renovation construction. The improved building codes will decrease the impact of risk hazards. Subdivision and land development enhancements will also augment this process. Ensuring that municipalities participate in the National Flood Insurance Program and encourage participation in the Community Rating System will decrease the impact as well.

Structure and infrastructure implementation: These actions involve modifying existing structures and infrastructure or constructing new structures to reduce hazard vulnerability. The following are examples:

- Acquisitions and elevations of structures in flood prone areas
- Utility undergrounding
- Structural retrofits

- Floodwalls and retaining walls
- Detention and retention structures
- Culverts
- Safe rooms

Structure and infrastructure implementation is a technique that removes or diverts the hazard from structure or protects the structure from a specific hazard. The new or renovated structures are therefore protected or have a reduced impact of hazards.

Natural Systems Protection: These are actions that minimize damage and losses and also preserve or restore the functions of natural systems. They include the following:

- Erosion and sediment control
- Stream corridor restoration
- Forest management
- Conservation easements
- Wetland restoration and preservation

Natural resource protection techniques allow for the natural resource to be used to protect or lessen the impact on new or renovated structures through the management of these resources. Utilization and implementation of the examples above will protect new and existing buildings and infrastructure.

Education and Awareness: These are actions to inform and educate citizens, elected officials and property owners about hazards and potential ways to mitigate them and may also include participation in national programs. Examples of these techniques include the following.

- Radio and television spots
- Websites with maps and information
- Real estate disclosure
- Provide information and training
- NFIP outreach
- StormReady
- Firewise communities

The education and awareness technique will protect and reduce the impact of specific hazards on new and existing buildings through education of citizens and property owners on the impacts that specific hazards could have on new or renovated structures. This information will allow the owner to make appropriate changes or enhancements that will lessen or eliminate the impacts of hazards.

Table 81 – Mitigation Strategy Technique Matrix provides a matrix identifying the mitigation techniques used for all low, moderate, and high-risk hazards in the county. The specific actions associated with these techniques are included in *Table 82 – 2023 Mitigation Action Plan*.

Table 81 - Mitigation Strategy Technique Matrix

Calvert County Mitigation Strategy Technique Matrix				
Hazard	**MITIGATION TECHNIQUE**			
	Planning and Regulations	**Structure and Infrastructure**	**Natural Systems Protection**	**Education and Awareness**
Coastal erosion	X	X	X	X
Drought	X	X		X
Earthquake	X	X		X
Extreme temperatures	X	X		X
Flooding, flash flooding, nuisance flooding	X	X	X	X
Hail	X	X		X
Hurricane and tropical storm	X	X		X
Invasive species	X	X		X
Landslide	X	X		X
Pandemic, epidemic, infectious disease	X	X		X
Radon exposure	X	X		X
Subsidence and sinkholes	X	X		X
Tornado and windstorm	X	X		X
Wildfire	X	X		X
Winter storm	X	X		X
Civil disturbance	X	X		X
Cyberterrorism	X	X		X
Dam failure	X	X		X
Emergency services	X	X		X
Environmental hazards	X	X		X
Nuclear incidents	X	X		X
Opioid epidemic	X	X		X
Terrorism	X	X		X
Transportation accidents	X	X		X
Utility interruptions	X	X		X

6.4. Mitigation Action Plan

The Calvert County Hazard Mitigation Local Planning Team (LPT) immediately began work on the mitigation strategy section of the 2023 hazard mitigation plan (HMP) update after the risk assessment section was completed. The LPT started this section by reviewing the 2017 HMP mitigation strategy section. A review of the previous goals, objectives, actions, and project opportunities documented in the 2017 HMP was conducted. The next step the LPT completed was the brainstorming of possible new actions based on newly identified risks. The LPT compiled all this information for presentations to the municipalities.

MCM Consulting Group, Inc. completed municipality meetings at various time periods via virtual platforms or in-person meetings. During all these meetings, an overview of mitigation strategy was presented, and the municipalities were informed that they needed to have at least one hazard-related mitigation action for their municipality. All municipalities were invited to attend these meetings. Municipalities that were not able to join conference calls were contacted individually.

The municipalities were notified of draft mitigation actions and encouraged to provide new mitigation actions that could be incorporated into the plan. Municipalities were provided copies of their previously submitted mitigation opportunity forms and asked to determine if the projects were still valid. Municipalities were solicited for new project opportunities as well. All agendas, sign in sheets, and other support information from these meetings is included in Appendix C.

Mitigation measures for the 2023 Calvert County HMP are listed in the mitigation action plan. *Table 82 – 2023 Mitigation Action Plan* is the 2023 Calvert County Mitigation Action Plan. This plan outlines mitigation actions and projects that comprise a strategy for Calvert County. The action plan includes actions, a benefit and cost prioritization, a schedule for implementation, any funding sources to complete the action, a responsible agency or department and an estimated cost. All benefit and cost analysis were completed using the most comprehensive cost prioritization and evaluation analysis tool, which follows the process as outlined by the State of Pennsylvania and Pennsylvania Emergency Management Agency. The completed analysis is located in Appendix H. *Table 82 – 2023 Mitigation Action Plan* is a matrix that identifies the county and/or municipalities responsible for mitigation actions in the new mitigation action plan. *Table 83 – Municipal Hazard Mitigation Actions Checklist* shows which actions tie to specific municipalities for responsibilities. *Table 84 – Objective to Action Checklist* shows that each mitigation objective has a mitigation action item related to it. *Table 85 – Actions Tied to Hazards* illustrates the specific actions that are tied to each hazard outlined in the hazard mitigation plan.

Funding acronym definitions:

FMA: Flood Mitigation Assistance Grant Program, administered by the Federal Emergency Management Agency

HMGP: Hazard Mitigation Grant Program, administered by the Federal Emergency Management Agency

BRIC: Building Resilient Infrastructure and Communities (BRIC) Program, administered by the Federal Emergency Management Agency

EMPG: Emergency Management Performance Grant, administered by the Federal Emergency Management Agency

HSGP: Homeland Security Grant Program, administered by the Federal Emergency Management Agency

Previously awarded grant projects and current grant projects for Calvert County are listed below:

- Complete full review and update of the Calvert County Flood Mitigation Plan by 2024
- Complete elevation of three homes that are repetitive loss properties due to flooding (awarded under the Hazard Mitigation Assistance Program, by December of 2024).
- Complete acquisition and demolition of one home in imminent danger of cliff collapse (awarded under the Hazard Mitigation Assistance Program, by December of 2024).
- Complete acquisition and demolition of three homes in imminent danger of cliff collapse (awarded under the Hazard Mitigation Assistance Program, by February of 2025).
- Complete acquisition and demolition of one home that is a repetitive loss property due to flooding (awarded under the Hazard Mitigation Assistance Program, by August of 2025).

Evaluate and Prioritize Mitigation Actions

Mitigation Action Evaluation:

Evaluating mitigation actions involves judging each action against certain criteria to determine whether or not it can be executed. This Maryland plan utilizes a Pennsylvania process for evaluation and prioritization because it comprehensively ties evaluation criteria to the individual mitigation actions. The feasibility of each mitigation action is evaluated using the ten evaluation criteria set forth in the Mitigation Action Evaluation methodology as outlined in the Commonwealth of Pennsylvania's All-Hazard Mitigation Planning, Standard Operating Guide and an eleventh selected by the Calvert County Local Planning Team. The methodology solicits input on whether each action is highly effective or feasible and ineffective or not feasible for the criteria. These criteria are listed below and aid in determining the feasibility of implementing one action over another.

- Life Safety: Will the action be effective in promoting public safety?
- Property Protection: Will the action be effective in protecting public or private property?
- Technical: How effective will the action be in avoiding or reducing future losses?
- Political: Does the action have public and political support?
- Legal: Does the community have the authority to implement the proposed measure?
- Environmental: Will the action provide environmental benefits, and will it comply with local, state, and federal environmental regulations?

- Social: Will the action be acceptable by the community, or will it cause any one segment of the population to be treated unfairly?
- Administrative: Is there adequate staffing and funding available to implement the action in a timely manner?
- Local Champion: Is there local support for the action to help ensure its completion?
- Historic Preservation: Will the action protect historic locations and sites, or assist with historic preservation?
- Other Community Objectives: Does the action address any current or future community objectives either through municipal planning or community goals?

To evaluate the mitigation actions, each action is identified as highly effective or feasible, ineffective, or not favorable and with no cost or benefit. For each criterion, the prioritization methodology assigns a "+" if the action is highly effective or feasible, a "-" if the action was ineffective or not feasible, and a "N" if no cost or benefit could be associated with the suggested action or the action was no applicable to the criteria.

Mitigation Action Prioritization:

Actions should be compared with one another to determine a ranking or priority by applying the multi-objective mitigation action prioritization criteria. Scores are assigned to each criterion using the following weighted, multi-objective mitigation action prioritization criteria:

- Effectiveness (weight: 20% of score): The extent to which an action reduces the vulnerability of people and property.
- Efficiency (weight: 30% of score): The extent to which time, effort, and cost is well used as a means of reducing vulnerability.
- Multi-Hazard Mitigation (weight: 20% of score): The action reduces vulnerability for more than one hazard.
- Address High Risk Hazard (weight: 15% of score): The action reduces vulnerability for people and property from a hazard identified as high risk.
- Address Critical Communications/Critical Infrastructure (weight: 15% of score): The action pertains to the maintenance of critical functions and structures such as transportation, supply chain management, and data circuits, etc.

Scores of 1, 2, or 3 are assigned for each multi-objective mitigation action prioritization criterion where 1 is a low score and 3 is a high score. Actions are prioritized using the cumulative score assigned to each. Each mitigation action is given a priority ranking (Low, Medium, and High) based on the following:

- Low Priority: 1.0 – 1.8

- Medium Priority: 1.9 – 2.4
- High Priority: 2.5 – 3.0

The cumulative results of the prioritization of mitigation actions is identified in the mitigation action evaluation and prioritization tool. The results for the mitigation action evaluation and prioritization are located in Appendix H.

Table 82 - 2023 Mitigation Action Plan

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
1.1.1	Structure and Infrastructure	Continue to support a regular maintenance program for emergency generators at the county's critical facilities and community lifeline facilities.	Utility Interruptions All Hazards	**X**			2023-2028	Local	Dept. of Public Safety Dept. of Tech Services
1.1.2	Structure and Infrastructure	Continue to conduct routine inspections, regular maintenance, and annual tests in all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event.	All Hazards	**X**			2023-2028	Local	Dept. of Public Safety, EM
1.1.3	Structure and Infrastructure	Continue to ensure that a planned, coordinated, and effective public warning dissemination program exists at the local level and is well maintained.	All Hazards	**X**			2023-2028	Local	Dept. of Public Safety
1.1.4	Structure and Infrastructure	Continue to maintain early warning systems through a variety of tools for designated critical facilities and community lifeline facilities.	All Hazards	**X**			2023-2028	Local	Dept. of Public Safety, EM
1.1.5	Structure and Infrastructure	Implement FEMA's Integrated Public Alert and Warning System (IPAWS) for sudden onset hazards such as tornados, thunderstorms, or flash floods.	Tornados Severe Storms Flash Floods	**X**			2023-2028	N/A	Dept. of Public Safety

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
1.1.6	Planning and Regulations	Continue to prepare for and coordinate sheltering during extreme weather events, including but not limited to vulnerable populations.	All Natural Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM Dept. of Comm. Resources Dept. of Social Services Red Cross CCHD
1.2.1	Planning and Regulations	Continue to identify at-risk populations (elderly, homeless, persons with physical or mental disabilities) to various hazards and maintain records of those vulnerable populations and the types of assistance they may need before, during, or after a hazard.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM Dept. of Comm. Resources Dept. of Social Services
1.2.2	Planning and Regulations	Utilize existing technical proficiency at the local level for conducting post-disaster damage assessments.	All Hazards	**X**			2023-2028	Local	Dept. of Public Safety Calvert County Munis.
1.2.3	Structure and Infrastructure	Continue to maintain and replace county owned critical infrastructure and community lifelines.	All Hazards	**X**			2023-2028	Local	Dept. of Public Works

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
1.2.4	Planning and Regulations	Improve the assessment and evaluation of potential impacts from natural hazards on historic properties in Calvert County by integrating asset and demographic data from the plan into vulnerability assessments.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM
1.3.1	Planning and Regulations	Develop a program for identification of areas that will be economically impacted by a hazard event including commercial, industrial, and institutional locations in the incorporated municipalities and unincorporated Town Centers.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM Calvert County Munis.
1.3.2	Planning and Regulations	Examine and research cybersecurity directives, best practices, and resources from the United States Department of Homeland Security's (US DHS) Cybersecurity & Infrastructure Security Agency (CISA) to lessen the impact of a potential cybersecurity event at the county.	Cyberterro rism		**X**		2023-2028	Local	Dept. of Tech. Services
1.3.3	Planning and Regulations	Implement any directives, best practices, or resources from CISA that would increase the resiliency of Calvert County from cyberterrorism and cyberattack.	Cyberterro rism	**X**			2023-2028	Local	Dept. of Tech. Services
1.3.4	Planning and Regulations	Continue to support county-wide response to the opioid epidemic.	Opioid Epidemic			**X**	2023-2028	Local	Dept. of Comm. Resources CCHD Dept. of Public Safety, EM

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
1.3.5	Planning and Regulations	Continue to prepare for and coordinate response to extreme heat and cold weather events.	Extreme Temperature		**X**		2023-2028	Local	Dept. of Comm. Resources CCHD Dept. of Public Safety, EM
1.3.6	Planning and Regulations	Continue to support the provision of county-wide mental health resources, education, and response.	All Hazards		**X**		2023-2028	Local	Dept. of Comm. Resources CCHD Dept. of Social Services
1.3.7	Planning and Regulations	Continue to support the implementation of critical incident stress management resources for career and volunteer first responders in the county.	Emergency Services		**X**		2023-2028	Local	Dept. of Public Safety
1.4.1	Structure and Infrastructure	Conduct an assessment of Calvert County emergency shelter locations and equipment at those shelters.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM
1.4.2	Planning and Regulations	Cross training county staff for emergency response or a hazard specific position during a disaster event.	All Hazards	**X**			2023-2028	Local	Dept. of Public Safety Calvert County Offices

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
1.5.1	Planning and Regulations	Research funding with the towns of Chesapeake Beach and North Beach to reinforce critical facilities and community lifelines including but not limited to emergency service locations, hospitals, and utility infrastructure.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM Calvert County Munis.
2.1.1	Planning and Regulations	Ensure reconstruction activities are compliant with NFIP substantial damage/improvement requirements and existing codes.	Flooding		**X**		2023-2028	Local	Dept. of P&Z
2.1.2	Planning and Regulations	Continue to provide technical assistance to local residents in applying for hazard mitigation assistance for acquisition/demolition, elevation, and localized flood risk reduction.	Flooding Flash Flooding		**X**		2023-2028	Local	Dept. of P&Z Dept. of Public Works
2.1.3	Structure and Infrastructure	Continue to coordinate with the County, municipality and/or the Maryland Department of Transportation on the potential feasibility of replacing, removing, or enlarging those bridge and culvert stream crossings that are unable to pass the 10-year frequency flood flow.	Flooding Flash Flooding		**X**		2023-2028	Local State	Dept. of Public Works Calvert County Munis. MDOT
2.2.1	Natural Systems Protection	Support the identification and implementation of stormwater management projects for flood risk reduction.	Flooding Flash Flooding	**X**			2023-2028	Local	Dept. of P&Z
2.3.1	Education and Awareness	Reduce vulnerability to wildfires by providing public education on increasing buffers and defensible spaces.	Wildfires			**X**	2023-2028	Local	Dept. of Public Safety, EM

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
2.3.2	Planning and Regulations	Make recommendations to the state realtor board to develop a disclaimer for developing along the cliffs.	Cliff Erosion		**X**		2023-2028	Local	Dept. of Public Safety, EM Dept. of P&Z
2.3.3	Natural Systems Protection	Collaborate on environmental features map for cliff mapping by category.	Cliff Erosion		**X**		2023-2028	Local	GIS Dept.
2.4.1	Planning and Regulations	Continue the process to meet requirements to become certified as a Storm Ready Community (by the National Weather Service StormReady® Program).	All Natural Hazards		**X**		2023-2028	HSG, Local	Dept. of Public Safety, EM
3.1.1	Planning and Regulations	Update the Comprehensive Plan's Hazard Mitigation Section and its assessment of hazard vulnerability and mitigation actions.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety Dept. of P&Z
3.1.2	Planning and Regulations	Develop and implement a post-disaster recovery plan in conjunction with the hazard mitigation plans.	All Hazards	**X**			2023-2028	Local	Dept. of Public Safety, EM MDEM, FEMA
3.1.3	Planning and Regulations	Continue to ensure county and municipal compliance with local Stormwater Management Plans.	Flooding Flash Flooding	**X**			2023-2028	Local	Dept. of Public Works
3.1.4	Planning and Regulations	Coordinate with Town Centers to integrate the Calvert County hazard mitigation plan into the Town Center master plans.	All Hazards		**X**		2023-2028	Local	Calvert County Town Centers

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
3.1.5	Planning and Regulations	Continue to ensure compliance with approved Erosion and Sedimentation Control Plans and continue to work with local farmers to implement BMPs.	Erosion	**X**			2023-2028	Local	Dept. of Public Works Calvert County Soil Cons. District
3.1.6	Planning and Regulations	Integrate a hazard mitigation section that reviews and evaluates the hazards that were rated highest on the risk factor analysis into the Chesapeake Beach and North Beach Comprehensive Plans.	All High-Risk Hazards	**X**			2023-2028	Local	Dept. of Public Safety, EM Calvert County Munis.
4.1.1	Structure and Infrastructure	Research information on structure retrofitting to meet standards related to high-risk hazards.	All High-Risk Hazards	**X**			2023-2028	Local	Dept. of Public Safety, EM
5.1.1	Education and Awareness	Continue to work with local radio stations to promote continuity of public awareness and disaster preparedness for all potential hazards in Calvert County.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety
5.1.2	Education and Awareness	Continue to distribute a public summary of this hazard mitigation plan including relevant information on hazard-prone areas, hazard specific "do's" and "don'ts" and emergency contact information.	All Hazards		**X**		2023-2028	Local	Public Relations Officer
5.1.3	Education and Awareness	Continue to encourage Calvert County citizens to be better prepared to face hazards by promoting and offering Community Emergency Response Team (CERT) training/classes to increase the number of citizen responders in the municipalities and population centers.	All Hazards		**X**		2023-2028	HSG	Dept. of Public Safety, EM

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
5.1.4	Education and Awareness	Conduct seminars as requested in schools on various hazards that could threaten the County and provide informational packets for students to take home.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM Calvert County BOE
5.1.5	Education and Awareness	Develop a more formal program with Calvert County schools for presentations related to high-risk hazards.	All High-Risk Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM Calvert County BOE
5.1.6	Education and Awareness	Utilize support to update training and educational materials on hazard mitigation including presentations and hand-outs.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM
5.1.7	Education and Awareness	Outreach to other community groups as requested on hazard mitigation and preparedness.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM
5.1.8	Education and Awareness	Maintain the Calvert Prepare mobile app to present hazard education and preparedness information to all stakeholders in the county.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM Dept. of Tech Services
5.1.9	Education and Awareness	Develop mailings for category one and two cliff adjacent properties annually for residents and property owners in Calvert County.	Cliff Erosion		**X**		2023-2028	Local	Dept. of P&Z

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
5.1.10	Education and Awareness	Develop additional mailers for local lenders and realtors in Calvert County related to cliffs.	Cliff Erosion		**X**		2023-2028	Local	Dept. of P&Z
5.1.11	Education and Awareness	Develop educational videos for cliff vulnerability across the county.	Cliff Erosion		**X**		2023-2028	Local	Dept. of P&Z
5.1.12	Education and Awareness	Develop annual press releases on cliff vulnerability and distribute to the public.	Cliff Erosion		**X**		2023-2028	Local	Dept. of P&Z
5.1.13	Education and Awareness	Develop an Emergency Management "Brand" to be the face of Emergency Preparedness and provide a trusted and reliable source of information to the public. Raise awareness of the County's Emergency Management Division and their roles and responsibilities.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM PIO Dept. of Comm. and Media Relations
5.1.14	Education and Awareness	Conduct data analytics of the county's emergency websites and media outlets to track the reach and efficacy of information including news posts, bulletins, and reading materials.	All Hazards		**X**		2023-2028	Local	Dept. of Tech Services Dept. of Comm. and Media Relations

Calvert County 2023 Mitigation Action Plan									
Action Number	**Mitigation Actions**		**Hazard Vulnerability**	**Prioritization**			**Implementation**		
	Category	**Description/ Action Items**		**High**	**Medium**	**Low**	**Schedule**	**Funding**	**Local Champion**
5.1.15	Education and Awareness	Identify and coordinate public information programs and events such as contests and festivals with public and private partners.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM PIO Calvert County Munis.
5.2.1	Planning and Regulations	Continue a community-specific stormwater maintenance program consisting of routine inspections and subsequent debris removal.	Flooding Flash Flooding	**X**			2023-2028	Local	Dept. of Public Works Calvert County Munis.
5.3.1	Structure and Infrastructure	Develop a presentation for structural retrofitting and actions homeowners can take to address protection in the event of a flooding hazard event.	Flooding	**X**			2023-2028	Local	Dept. of Public Safety, EM
5.4.1	Planning and Regulations	Research funding that is available for hazard mitigation in Calvert County and Maryland.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM
5.5.1	Planning and Regulations	Work with local businesses and local industry owners to develop a continuity of operations plan.	All Hazards	**X**			2023-2028	Local	Dept. of Economic Develop. Dept. of P&Z Calvert County Munis.

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
5.6.1	Planning and Regulations	Recommend to the Board of Education to develop and implement a natural hazards awareness curriculum.	All Natural Hazards		**X**		2023-2028	N/A	County PR Officer BOE MDEM, FEMA
5.6.2	Structure and Infrastructure	Continue to maintain relationships with the county school board to enhance the county's shelter capabilities.	All Natural Hazards		**X**		2023-2028	N/A	Dept. of Public Safety, EM
5.6.3	Planning and Regulations	Work with the board of education to introduce and conduct tornado drills in schools and educate children and families about the growing threat of tornados.	Tornado and Windstorm		**X**		2023-2028	Local	Dept. of Public Safety, EM PIO
5.6.4	Education and Awareness	Continue to coordinate with county PIO to develop a "pre-approved' set of releases to be disseminated to the public in a timely manner in the event of an emergency.	All Hazards	**X**			2023-2028	Local	Dept. of Public Safety, EM PIO
6.1.1	Planning and Regulations	Maintain zoning ordinance provisions for protection of all hazard areas.	All Hazards	**X**			2023-2028	N/A	Dept. of P&Z Calvert County Munis.
6.2.1	Natural Systems Protection	Identify natural resources that provide natural mitigation such as wetlands, buffers, etc. and make them a priority for conservation.	Flooding Flash Flooding	**X**			2023-2028	Local	Dept. of P&Z
6.2.2	Natural Systems Protection	Give high priority to undeveloped floodplain areas, forested wetlands, and emergent wetlands for natural preservation.	Flooding Flash Flooding	**X**			2023-2028	Local	Calvert County Munis. CCDNR

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
7.1.1	Planning and Regulations	Continue existing drills and exercises and expand those programs as able.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM
7.1.2	Planning and Regulations	Coordinate with the state to implement a recurring training and exercise program to validate plans, maintain capabilities, and ensure NIMS compliance.	All Hazards		**X**		2023-2028	Local	Dept. of Public Safety, EM Calvert County Munis.
7.2.1	Planning and Regulations	Develop agreements between Calvert County and local jurisdictions, regional organizations, and the state of Maryland to share GIS data and vulnerability datasets to address hazards.	All Hazards	**X**			2023-2028	Local	Dept. of Public Safety, EM Calvert County Munis.
8.1.1	Education and Awareness	Distribute educational materials about the HHPD program to municipalities, communities, and county residents.	Dam Failure			**X**	2023-2028	Local	Dept. of Public Safety, EM
8.2.1	Education and Awareness	Provide education on local mitigation policies and programs that address high-hazard potential dams to municipalities and county residents.	Dam Failure			**X**	2023-2028	Local	Dept. of Public Safety, EM
8.2.2	Planning and Regulations	Ensure collaboration with both private and public dam owners, to ensure that their input is included in the local planning team, and the planning process in general.	Dam Failure		**X**		2023-2028	Local, HHPD	Dept. of Public Safety, EM Calvert County LPT

Calvert County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Local Champion
8.2.3	Natural Systems Protection	Research the feasibility of installing flood protection measures in areas around Calvert County that would be adversely impacted by flooding from a high-hazard potential dam failure, including natural spaces, local parks, and outdoor areas.	Dam Failure			**X**	2023-2028	Local, HHPD	Conservation District Calvert County LPT
8.2.4	Structure and Infrastructure	If funding becomes available, perform acquisitions, elevations, relocations, and foundation stabilization on homes and structure within areas of potential impact from a failure of a high-hazard potential dam in Calvert County.	Dam Failure		**X**		2023-2028	Local, HHPD	Conservation District Calvert County LPT
8.2.5	Structure and Infrastructure	Review the early warning systems in place for dams in Calvert County. If no early warning systems are in place, research the feasibility of constructing or implementing those systems.	Dam Failure		**X**		2023-2028	Local, HHPD	Dept. of Public Safety Calvert County LPT
8.2.6	Planning and Regulations	Review or develop evacuation plans for Calvert County high-hazard dams.	Dam Failure			**X**	2023-2028	Local, HHPD	Dept. of Public Safety, EM Calvert County LPT
8.3.1	Education and Awareness	Acquire or maintain digitized dam inundation GIS polygons to determine at risk populations for dams designated High-Hazard Potential Dams by FEMA.	Dam Failure			**X**	2023-2028	Local, HHPD	GIS Dept. Dept. of Public Safety, EM

Table 83 - Municipal Hazard Mitigation Actions Checklist

Municipal Hazard Mitigation Actions Checklist							
Municipality	**1.1.1**	**1.1.2**	**1.1.3**	**1.1.4**	**1.1.5**	**1.1.6**	**1.2.1**
Town of Chesapeake Beach							

Municipal Hazard Mitigation Actions Checklist							
Municipality	**1.1.1**	**1.1.2**	**1.1.3**	**1.1.4**	**1.1.5**	**1.1.6**	**1.2.1**
Town of North Beach							
Calvert County or county office	X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist								
Municipality	**1.2.2**	**1.2.3**	**1.2.4**	**1.3.1**	**1.3.2**	**1.3.3**	**1.3.4**	**1.3.5**
Town of Chesapeake Beach	X			X				
Town of North Beach	X			X				
Calvert County or county office	X	X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**1.3.6**	**1.3.7**	**1.4.1**	**1.4.2**	**1.5.1**	**2.1.1**	**2.1.2**
Town of Chesapeake Beach					X		
Town of North Beach					X		
Calvert County or county office	X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**2.1.3**	**2.2.1**	**2.3.1**	**2.3.2**	**2.3.3**	**2.4.1**	**3.1.1**
Town of Chesapeake Beach	X						
Town of North Beach	X						
Calvert County or county office	X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist						
Municipality	**3.1.2**	**3.1.3**	**3.1.4**	**3.1.5**	**3.1.6**	**4.1.1**
Town of Chesapeake Beach					X	
Town of North Beach					X	
Calvert County or county office	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**5.1.1**	**5.1.2**	**5.1.3**	**5.1.4**	**5.1.5**	**5.1.6**	**5.1.7**
Town of Chesapeake Beach							
Town of North Beach							
Calvert County or county office	X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**5.1.8**	**5.1.9**	**5.1.10**	**5.1.11**	**5.1.12**	**5.1.13**	**5.1.14**
Town of Chesapeake Beach							
Town of North Beach							
Calvert County or county office	X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**5.1.15**	**5.2.1**	**5.3.1**	**5.4.1**	**5.5.1**	**5.6.1**	**5.6.2**
Town of Chesapeake Beach	X	X			X		
Town of North Beach	X	X			X		
Calvert County or county office	X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**5.6.3**	**5.6.4**	**6.1.1**	**6.2.1**	**6.2.2**	**7.1.1**	**7.1.2**
Town of Chesapeake Beach			X		X		X
Town of North Beach			X		X		X
Calvert County or county office	X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**7.2.1**	**8.1.1**	**8.2.1**	**8.2.2**	**8.2.3**	**8.2.4**	**8.2.5**
Town of Chesapeake Beach	X						
Town of North Beach	X						
Calvert County or county office	X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**8.2.6**	**8.3.1**					
Town of Chesapeake Beach							
Town of North Beach							
Calvert County or county office	X	X					

Table 84 - Objective to Action Checklist

Objective	Number of Actions
1.1	6
1.2	4
1.3	7
1.4	2
1.5	1
2.1	3
2.2	1
2.3	3
2.4	1
3.1	6
4.1	1
5.1	15
5.2	1
5.3	1

Objective	Number of Actions
5.4	1
5.5	1
5.6	1
6.1	1
6.2	2
7.1	2
7.2	1
8.1	1
8.2	6
8.3	1

Table 85 - Actions Tied to Hazard

Actions Tied to Hazard	
Hazard	**Actions Related**
Coastal erosion	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.3.2, 2.3.3, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.5, 3.1.6, 4.1.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Drought	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Earthquake	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Extreme temperatures	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.5, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Flooding, flash flooding, nuisance flooding	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.4.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 4.1.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.2.1,

Actions Tied to Hazard	
Hazard	**Actions Related**
	5.3.1, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 6.2.1, 6.2.2, 7.1.1, 7.1.2, 7.2.1
Hail	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Hurricane and tropical storm	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Invasive species	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Landslide	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.10, 5.1.11, 5.1.12, 5.1.13, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Pandemic, epidemic, infectious disease	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Radon exposure	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Subsidence and sinkholes	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15,

Actions Tied to Hazard	
Hazard	**Actions Related**
	5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Tornado and windstorm	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.6, 1.2.11.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.3, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Wildfire	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.3.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Winter storm	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 2.4.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.1, 5.6.2, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Civil disturbance	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Cyberterrorism	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.2, 1.3.3, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 7.1.1, 7.1.2, 7.2.1
Dam failure	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1, 8.1.1, 8.2.1, 8.2.2, 8.2.3, 8.2.4, 8.2.5, 8.2.6, 8.3.1
Emergency services	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.3.7, 1.4.1, 1.4.2, 1.5.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Environmental hazards	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 3.1.1, 3.1.2, 3.1.4,

Actions Tied to Hazard	
Hazard	**Actions Related**
	3.1.6, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Nuclear incidents	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Opioid epidemic	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.4, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Terrorism	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Transportation accidents	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1
Utility interruptions	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.1, 1.3.6, 1.4.1, 1.4.2, 1.5.1, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 4.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.7, 5.1.8, 5.1.9, 5.1.14, 5.1.15, 5.1.16, 5.4.1, 5.5.1, 5.6.4, 6.1.1, 7.1.1, 7.1.2, 7.2.1

7. Plan Maintenance

7.1. Update Process Summary

Monitoring, evaluating, and updating this plan is critical to maintaining its value and success in Calvert County 's hazard mitigation efforts. Ensuring effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. This section explains who will be responsible for maintenance activities and what those responsibilities entail. It also provides a methodology and schedule of maintenance activities including a description of how the public will be involved on a continued basis. This HMP update also defines the municipalities' role in updating and evaluating the plan. Finally, the 2023 HMP update encourages continued public involvement and how this plan may be integrated into other planning mechanisms in the county.

7.2. Monitoring, Evaluating and Updating the Plan

Hazard mitigation planning in Calvert County is the responsibility of all levels of government (i.e., county, and local), as well as the citizens of the county. The Calvert County Local Planning Team will be responsible for maintaining this multi-jurisdictional HMP. The local planning team will meet annually and following each emergency declaration to review the plan. The Emergency Management Specialist and the Mitigation Specialist with the Calvert County Division of Emergency Management will be the primary individuals responsible for reviewing and updating the plan at least once every five years. Every municipality that has adopted this plan will also be afforded the opportunity to provide updated information or information specific to hazards encountered during an emergency or disaster. Each review process will ensure that the hazard vulnerability and risk analysis reflect the current conditions of the county, that the capabilities assessment accurately reflects local circumstances and that the hazard mitigation strategies are updated based on the county's damage assessment reports and local mitigation project priorities. The HMP must be updated on a five-year cycle. An updated HMP must be completed and approved by the end of the five-year period. The monitoring, evaluating, and updating of the plan every five years will rely heavily on the outcomes of the annual HMP planning team meetings.

The Calvert County Local Planning Team will complete a hazard mitigation progress report to evaluate the status and accuracy of the multi-jurisdictional HMP and record the local planning team's review process. The annual plan review will be distributed to appropriate representatives at both MDEM and FEMA. The following items will be completed during the annual review and reporting process:

- Review the risk assessment section and identify occurrences of hazards within the last year. Identify date, time, damage, fatalities, and other specific information of the events. Also identify any new hazards that have occurred or increased risk with the county.

- Complete a review and update of the capability assessment section. Identify any capability weaknesses since the last review. The capability assessment surveys from the previous hazard mitigation plan will be reviewed and new capability assessment forms can be distributed to the incorporated municipalities during the annual review.
- Complete a review of the mitigation strategy section. Review the goals and objectives identified in the 2023 HMP and determine if any updates are needed. Provide all mitigation actions and opportunities to the county and municipalities that are applicable. Have all entities complete an action review matrix and document all results in the report. Also, add any new actions that are identified. Complete a review of each mitigation opportunity and identify the status of each opportunity on the opportunity review spreadsheet. All information will be included in the annual review report.

The Calvert County Division of Emergency Management will maintain a copy of these records and place them in Appendix I of this plan. Calvert County will continue to work with all municipalities regarding hazard mitigation projects, especially those municipalities that did not submit projects for inclusion in this plan.

The Calvert County local planning team should also be reviewed annually to address any changes to the membership that may have occurred over the past calendar year. The LPT can be expanded and updated with new stakeholders to address potential changes in guidance by the State of Maryland and the Federal Emergency Management Agency.

7.3. Continued Public Involvement

The Calvert County Division of Emergency Management will ensure that the 2023 Calvert County Hazard Mitigation Plan is posted and maintained on the Calvert County website and will continue to encourage public review and comment on the plan. The Calvert County website on which the plan will be located is Emergency Management | Calvert County, MD - Official Website (calvertcountymd.gov)

The public will have access to the 2023 Calvert County HMP through their local municipal office, the Calvert County Planning Department, or the Calvert Division of Emergency Management. Information on upcoming events related to the HMP or solicitation for comments will be announced via newsletters, newspapers, mailings, and the county website.

The citizens of Calvert County are encouraged to submit their comments to elected officials and/or members of the Calvert County HMP Local Planning Team. To promote public participation, the Calvert County Local Planning Team will post a public comment form as well as the Hazard Mitigation Project Opportunity Form on the county's website. These forms will offer the public various opportunities to supply their comments and observations. All comments received will be maintained and considered by the Calvert County Hazard Mitigation Planning Team.

Once the Calvert County 2023 Hazard Mitigation Plan is adopted by the Calvert County Board of County Commissioners, the plan will be disseminated to various county agencies and local municipalities that develop and implement specific plans and ordinances. Each participating municipality, including the Towns of Chesapeake Beach and North Beach, will be responsible for implementing the specific recommendations in section 5.2.5, plan integration, of the capability assessment into their local planning documents including comprehensive plans, zoning ordinances, land development, and subdivision regulations. Whenever possible, the Calvert County Division of Emergency Management will serve as a liaison to assist with these integrations and updates. As discussed above in section 7.2, progress on multi-jurisdictional plan integration will be addressed as part of the annual review conducted by the Calvert County Local Planning Team.

8. Plan Adoption

8.1. Resolutions

In accordance with federal and state requirements, the governing bodies of each participating jurisdiction must review and adopt by resolution, the 2023 Calvert County Hazard Mitigation Plan. Copies of the adopting resolutions are included in this plan in Appendix J. FEMA Region III in Philadelphia, Pennsylvania is the final approval authority for the Hazard Mitigation Plan. MDEM also reviews the plan before submission to FEMA.

9. Appendices

APPENDIX A:	**References**
APPENDIX B:	**FEMA Local Mitigation Review Tool**
APPENDIX C:	**Meetings and Support Documents**
APPENDIX D:	**Municipal Flood Maps**
APPENDIX E:	**Critical and Community Lifeline Facilities**
APPENDIX F:	**2023 HAZUS Reports**
APPENDIX G:	**2023 Mitigation Project Opportunities**
APPENDIX H:	**2023 Mitigation Action Evaluation & Prioritization**
APPENDIX I:	**Annual Review Documentation**
APPENDIX J:	**Calvert County & Municipal Adoption Resolutions**
APPENDIX K:	**Calvert County Flood Mitigation Plan**